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THE TAPIOCA INDUSTRY

IN

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W.MALAYSIA

(ECONOMIC SURVEY)

BY

O.WAHBY
MARKETING EXPERT

C.G.ERIKSEN
MARKETING ASSOC. EXPERT

TR/103

DECEMBER 1969

FOOD AND AGRICULTURE ORGANIZATION
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MINISTRY OF AGRICULTURE AND CO-OPERATIVES,
DIVISION OF FOOD TECHNOLOGY

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I. INTRODUCTION

Cassava (tapioca) plants are grown in West Malaysia for two main purposes: -

(1) For fresh human consumption for:
    a. Home and b. Market
(2) For further root processing into:
    a. Animal feed in the form of dried sliced roots (Chips)
    b. Starch products in the form of
        (i) tapioca flour
        (ii) tapioca pearl
        (iii) tapioca flakes
    c. Starch by products for animal feed in the form of tapioca refuse and low grade starch (scum)

Other primitive forms of processing carried out at the farm level result in the production of impure starch for further processing by starch factories.

The sweet (edible) short-term tapioca variety is grown mainly for fresh consumption and, as such, its cultivation is widely scattered all over the country.

The bitter long-term variety is grown for processing into the various tapioca products and, its cultivation is, therefore, concentrated around the starch and chip processing plants the majority of which is found in the state of Perak. Because of the fact that the industrial variety lends itself to the development of an agricultural based industry, this survey is concerned only with tapioca cultivation meant for processing.

Malaysian tapioca products find their way both into the domestic and foreign markets. Tapioca chips and refuse are sold mainly domestically as animal feed while starch products are sold mainly in the

foreign markets bringing in about $5 million annually in foreign exchange * and partly in the domestic market to food, chemical, and other industries.

A. Need for the Survey

As reflected in the First Malaysia Plan (1966-1970) the Government became aware of the need to take action "to stimulate new kinds of economic activity both agricultural and industrial, so as to reduce the nation's dependence on rubber and tin". One of the long-term objectives of agricultural and rural development as stated in the Plan is "the creation of linkeages between agriculture and agriculturally-based secondary industries ----- Particularly promissing food industries include dairy products and other processed foods as well as tapioca starch industries. * *

The development and expansion of the tapioca industry in Malaysia obviously requires, as a logical precondition, close examination of its present situation and of the problems affecting its performance and impeding its potential development. In addition, factors determining the potentialities for production, processing and marketing expansions should also be identified and analysed. The need to investigate these aspects of the tapioca industry is further justified by the apparent problems and characteristics of the present industry structure which may be summarized as follows: -

* External Trade Statistics W. Malaysia

* * Thailand, the largest exporter of tapioca products in the world, developed its industry in connection with a programme of agricultural diversification . It has succeeded in developing new crops in post-war years to move away from rice monoculture; these include cassava roots and maize. Output of cassava roots jumped to almost nine times what it was fifteen years ago.

(1) The present land use and alienation regulations, which discourage or at least do not encourage tapioca cultivation in some states in West Malaysia.

(2) The existence of sizeable land acreages in various states suitable for growing tapioca provided proper soil conservation and fertilization practices are adopted.

(3) The availability of foreign and domestic markets for the quantity and quality of starch products at present produced.

(4) The striking expansion which has been taking place in the poultry and pig industries and the existing potentialities for the growth of other livestock industries, resulting in a substantial increase in domestic demand for animal feed compounds of which tapioca is a significant component.

(5) Predominance of illegal cultivation to supply the existing tapioca processing factories.

(6) Uncertainty of tapioca root supply and of its flow regularity.

(7) Root transportation problems resulting from imbalance in geographical distribution between cultivated areas and processing factories.

(8) The tapioca processing industry is, at present, technologically underdeveloped, which, coupled with excessive delay in processing after harvest, results in a quality short of a competitive level if a bigger share in the world market is to be captured.

(9) On a price basis the competitiveness of the Malaysian tapioca products in the world market could be considerably improved through reduction in cost of production processing and marketing. A strong support for the hypothesis that "there is a large room for cost reduction" is based on the simple

fact that the whole industry has been until very recently, neglected by Government departments and research bodies concerned.

It is, therefore, imperative that more insight should be develop- into the present status and functioning of the tapioca industry and s development potentials. This would enable policy makers to put the dustry in its proper perspective within the context of the agricultural d rural development policy

B. Purpose of the Survey

The purpose of this survey may be outlined as follows: -

(1) To study the present situation of the industry with regard to economic aspects of production, marketing and processing of cassava roots and of marketing of final products.

(2) To investigate economic factors governing potential expansion of the industry in the context of present and future expansion trends and agricultural diversification policy.

(3) To study marketing prospects domestic and foreign - of present and potential production.

(4) To formulate relevant recommendations for presentation to policy makers.

II. WORLD PRODUCTION AND TRADE

A. Production

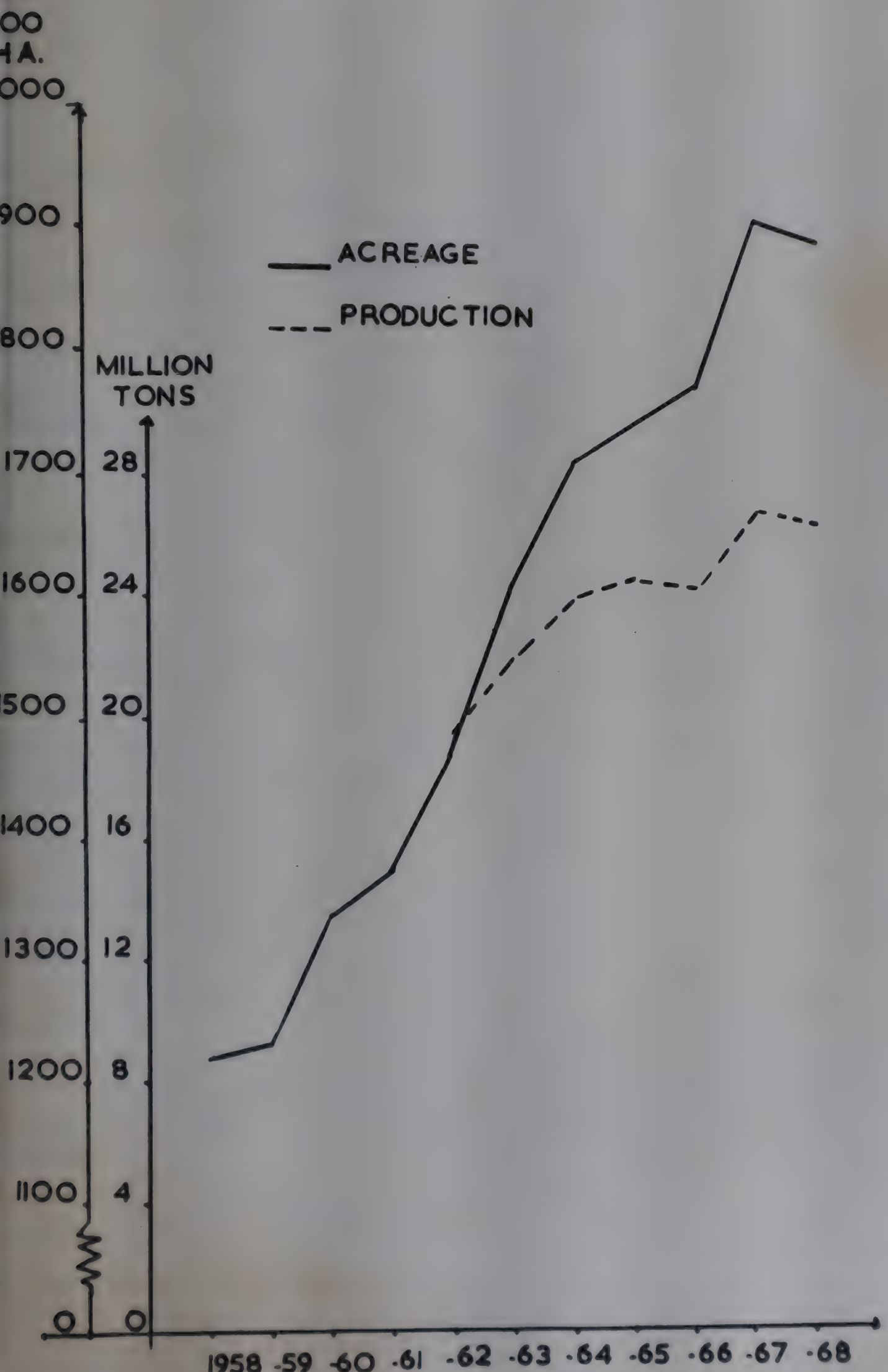
Cassava acreage statistics published for the major producing countries as well as for Malaysia unfortunately do not distinguish between sweet (freshly consumed) and bitter (industrial) varieties. It is, therefore, difficult to determine, without actual field survey or close examination, the portion of acreage cultivated for fresh consumption and that which is geared toward processing. This difficulty is accentuated by the fact that tapioca sweet variety is commonly grown as a backyard crop for home consumption. Thus, the aggregate acreage statistics might lack acceptable accuracy if a considerable portion of this acreage represented the sweet variety. Moreover, the per acre yield figures would be considerably misleading to use as such or to generalize for large industrial variety acreage, since it would be based on many tiny plots of sweet variety receiving exceptional treatment.

Many countries of tropical climate cultivate tapioca in varying acreages. However, since tapioca in many cases, is cultivated as a subsistance crop for domestic human consumption, only limited number of tapioca producing countries enter into world trade.

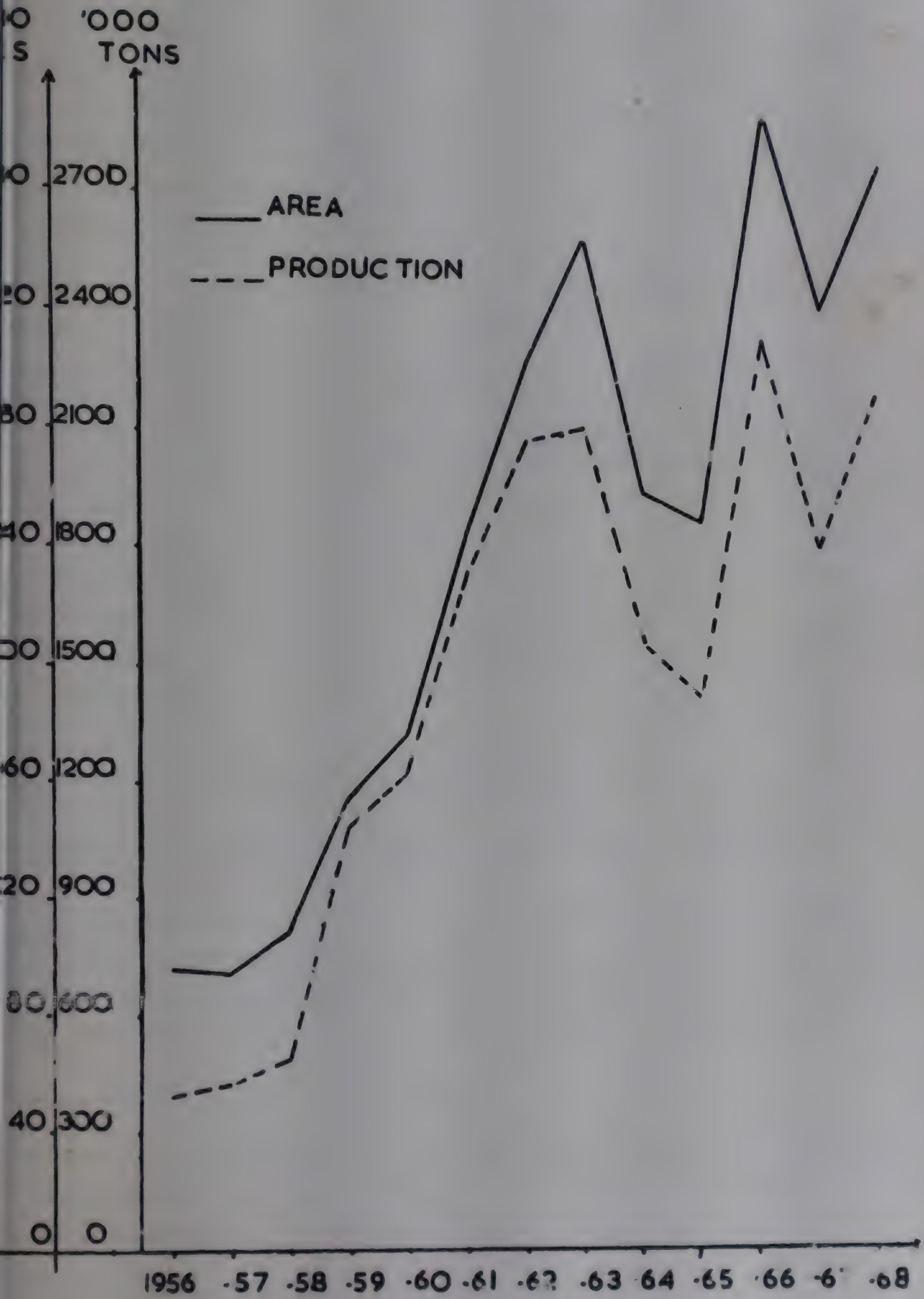
Brazil, the largest tapioca producing country in the world, has been expanding its acreage and production annually. Thailand, the largest tapioca exporting country in the world has also maintained a general increasing trend in acreage and production. However, Thai tapioca growers have recently been switching to sugar cane cultivation as more sugar factories were established throughout the country.

APIOCA PRODUCTION AND ACREAGE

OF BRAZIL



TAPIOCA PRODUCTION AND ACREAGE IN THAILAND



- The following table represents area, production and yield of the seven major tapioca exporting countries in the world in addition to World total; area and production for the seven countries are for 1968 and yield represents the previous three-year (1965 to 1967) weighted average. For the world total, area, production and yield are for 1967:

Country	1968		1965 - 67 Yield Weighted Ave
	Area 1,000 Hectares	Production 1,000 Metric Tons	100 kg. /Hectare
Brazil	1,900	26,800	141
Indonesia	1,600	11,800	75
W. Malaysia	20	310	155
Thailand	150	2,200	144
Angola	120	1,530	128
Madagascar	280	800	29
Togo	150	1,120	73
World Total(1967)	9,584	82,570	86

Source: FAO Production Year Book. Yield weighted averages are computed.

It can be observed from this table that among major exporting countries, West Malaysia has the smallest acreage and production but the highest yield per land unit measure - given the reliability of the data.

B. Trade

Surplus production over and above domestic consumption enters international trade under different forms such as sliced dried roots, flour, meal, or as tapioca starch. Dried cassava roots

and meal are used as raw material for compound feeding stuff, while tapioca starch is used for industrial purposes along with other kinds of starches. Grocery tapioca is solely used for human consumption.

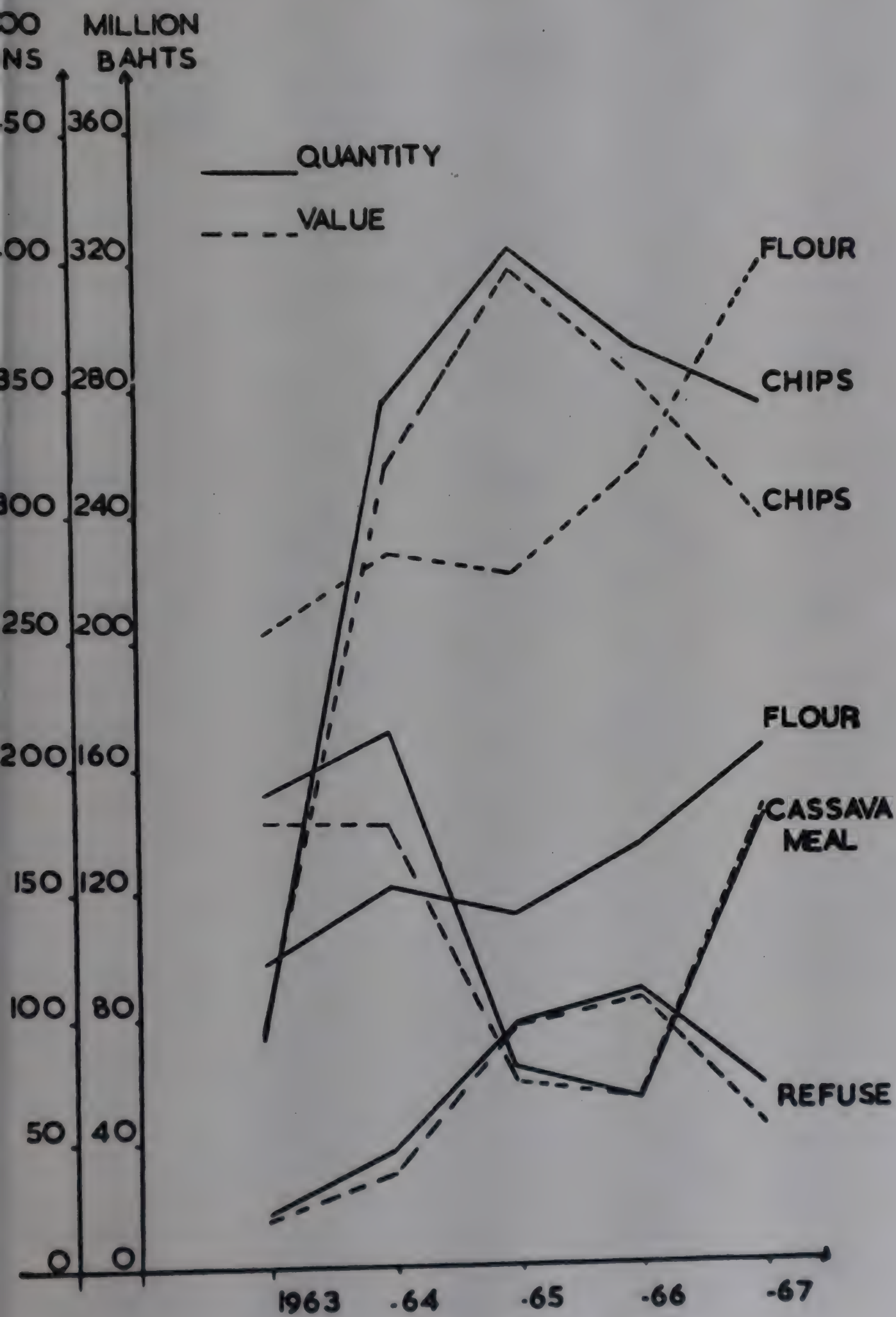
1. Exports

Exports of tapioca products have been generally increasing over the past 10 years. Considerable fluctuations in exports have, however, been observed among some exporting countries. Thailand is by far the largest exporting country with a total export of about 808,000 metric tons of various tapioca products in 1967. The corresponding figure for West Malaysia is about 16,500 metric tons. Though Brazil has the largest acreage and production among the major exporting countries, it has exported only 21.3 thousand metric tons of tapioca products in 1967 principally to the U.S. The rest has been mostly used locally for fresh consumption as roots, although large amounts were processed into tapioca products for use in Brazilian industries. In the previous three years, however, Brazil exported much larger quantities due to a sharp increase in cassava flour export in addition to the introduction of "Mandioca" product to the export market.

The following table shows a comparison between the major exporting countries (except Indonesia, for which export figures are not available since 1963) with respect to quantity exported in relation to production for 1967:-

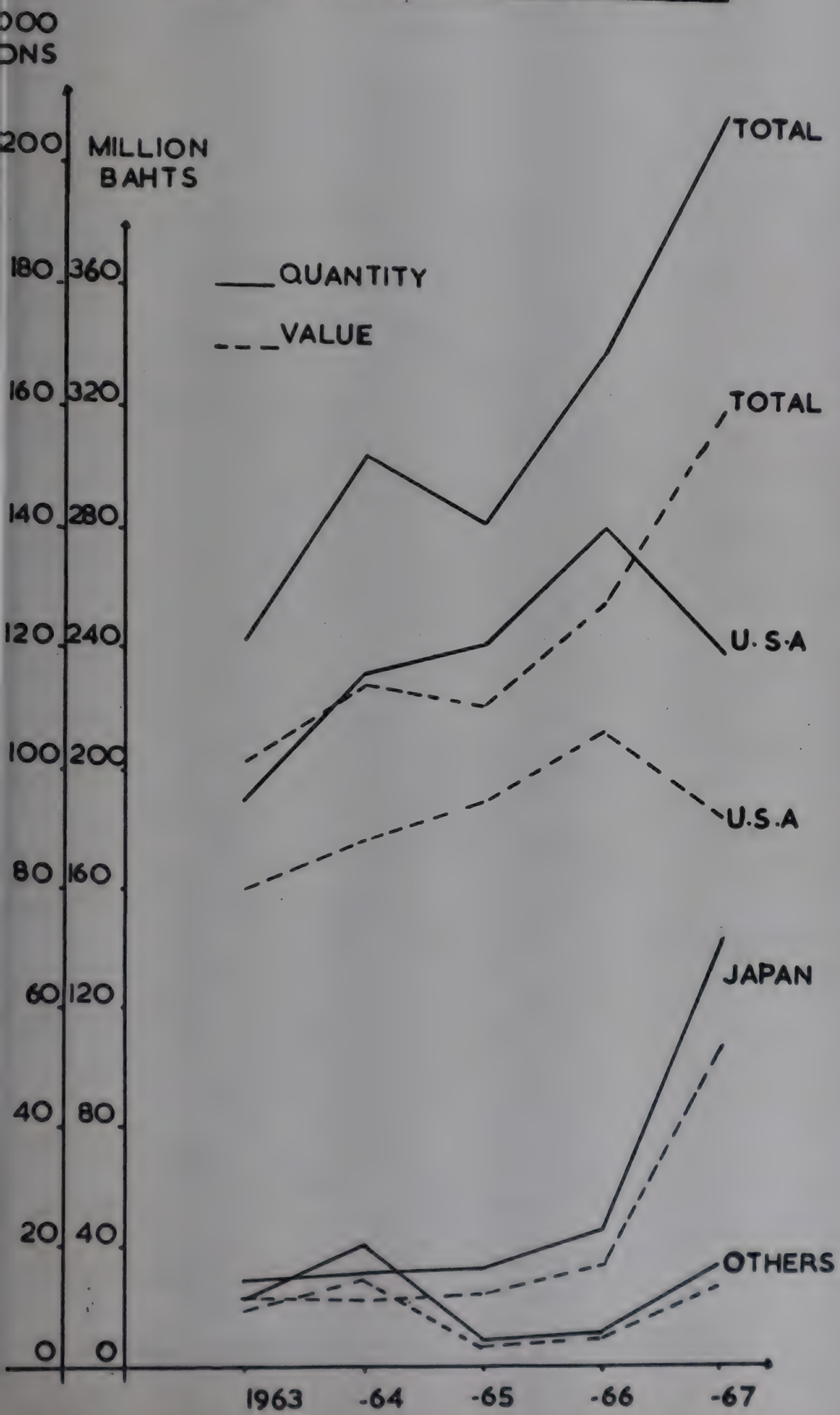
	1967		
	Production 1,000 Metric Tons	Export 1,000 Metric Tons	Export/Production %
Brazil	27,268	21.3	0.08
Thailand	1,800	808.0	44.89
W. Malaysia	310	16.5	5.32
Madagascar	900	17.2	1.91
Togo	1,118	3.3	0.30
Angola	1,525	49.8	3.27

TOTAL EXPORT OF TAPIOCA PRODUCT FROM THAILAND BREAKDOWN BY PRODUCT



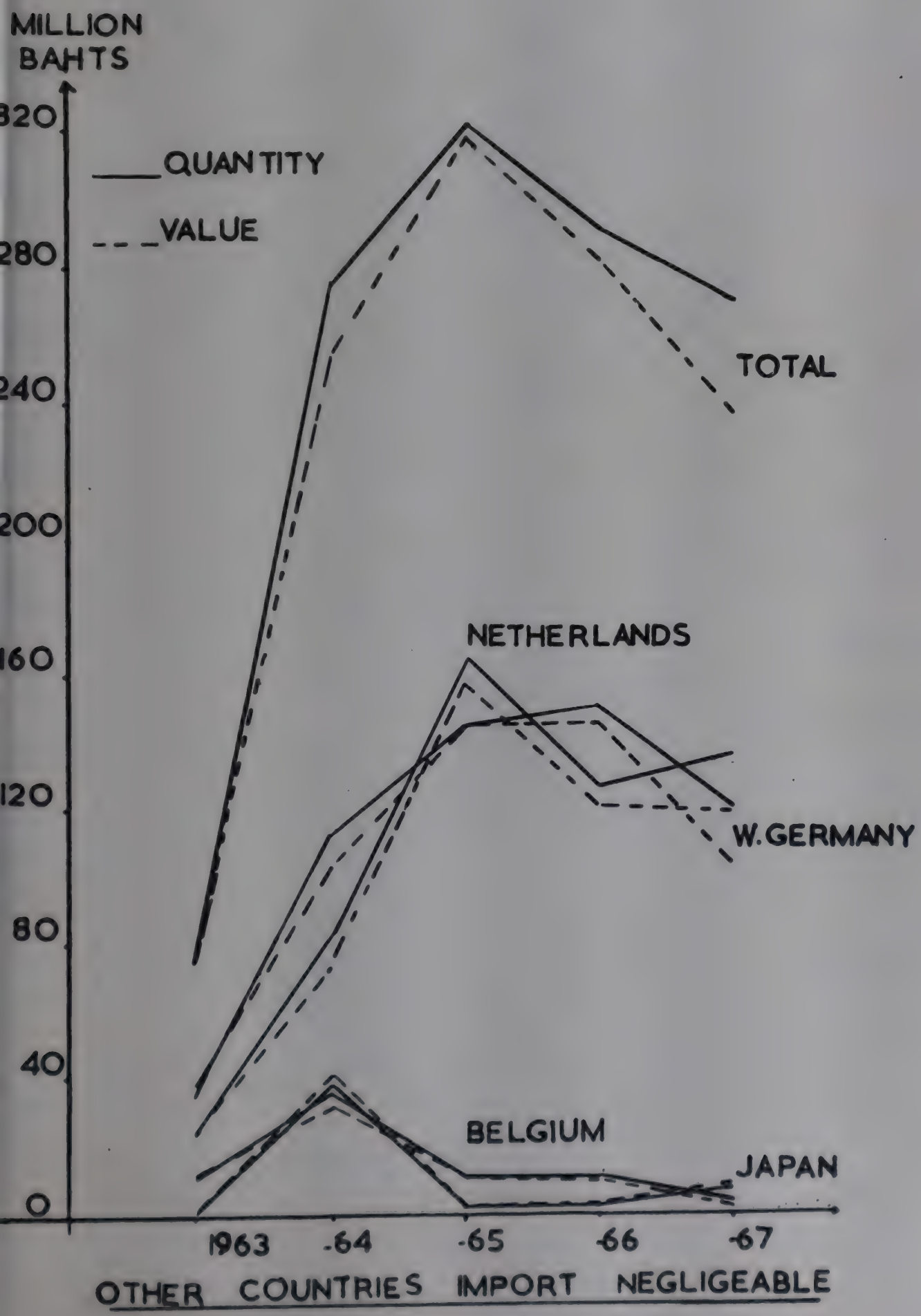
'ORT OF CASSAVA FLOUR FROM THAILAND P.I

BREAKDOWN BY COUNTRY



ORT OF CASSAVA CHIPS FROM THAILAND

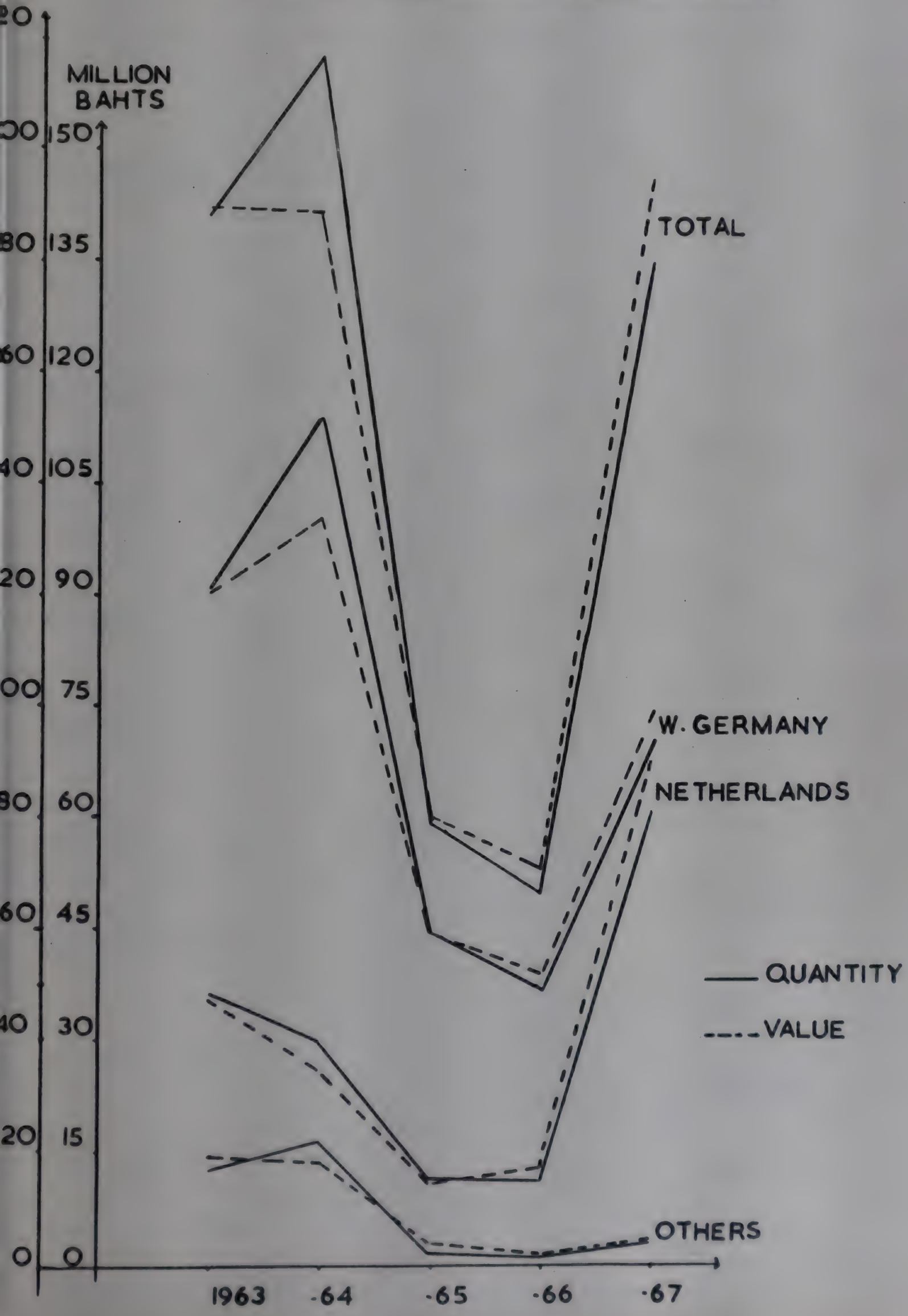
BREAKDOWN BY COUNTRY



OTHER COUNTRIES IMPORT NEGLIGEABLE

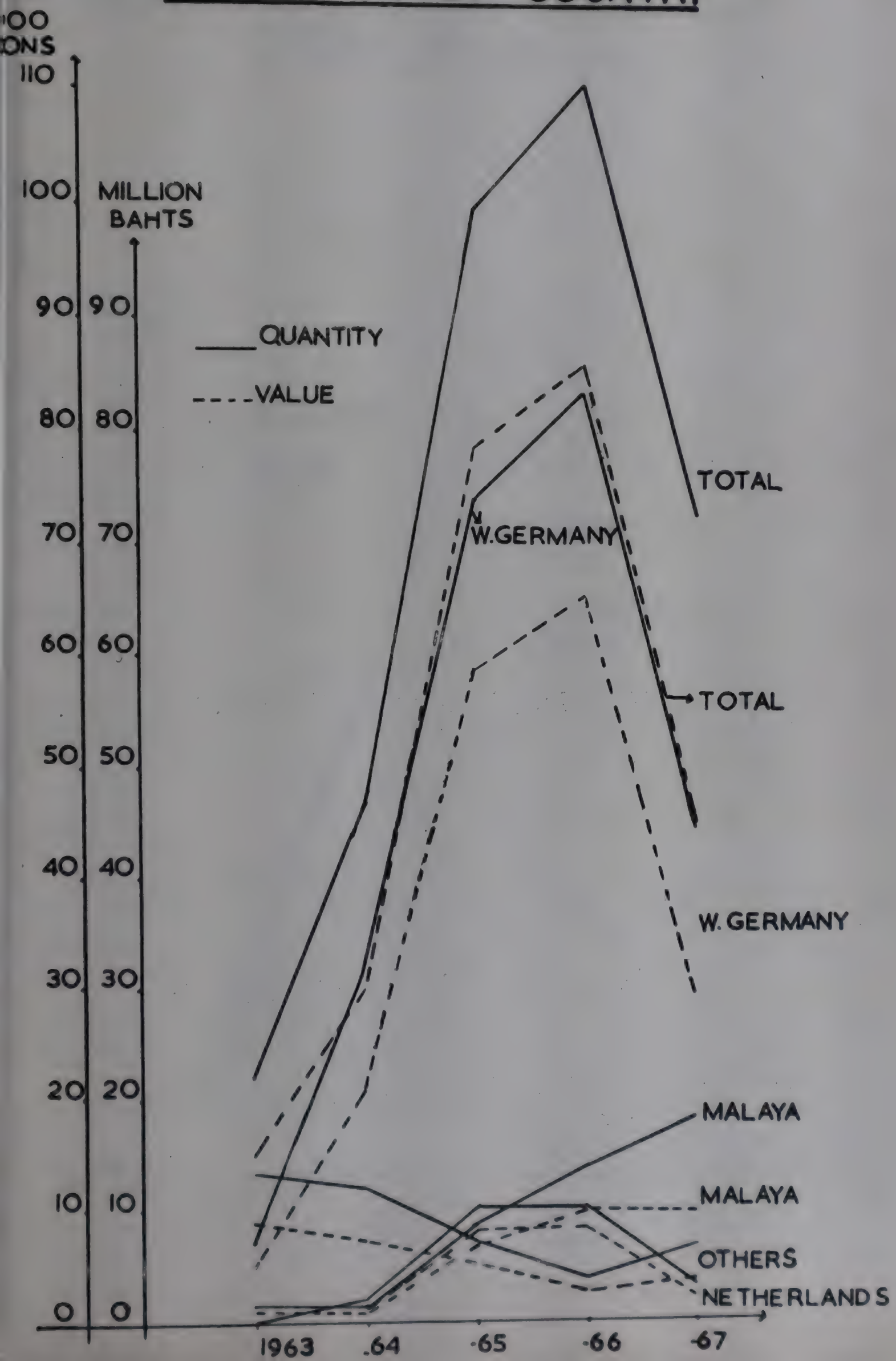
EXPORT OF CASSAVA MEAL FROM THAILAND

BREAKDOWN BY COUNTRY

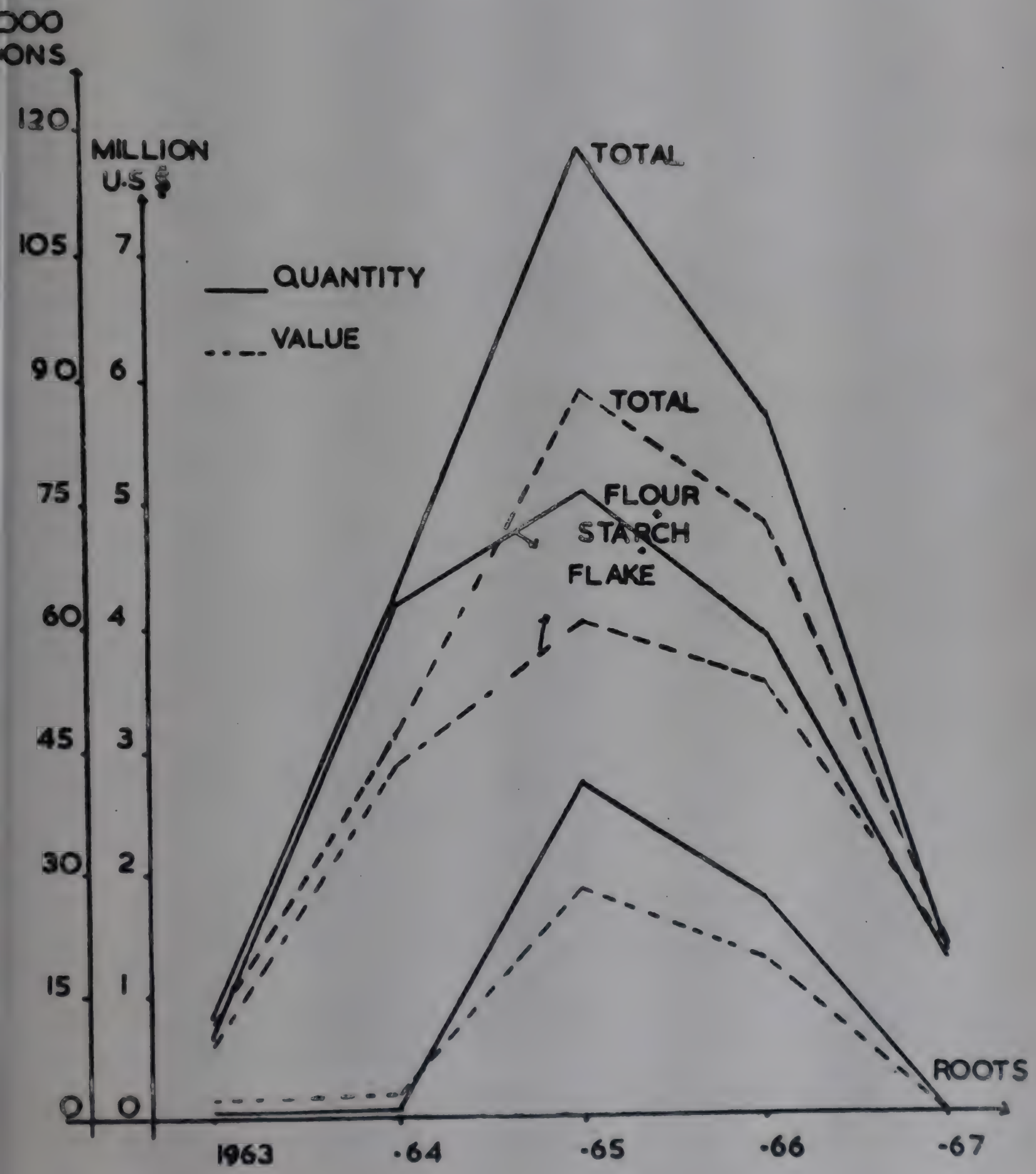


PORT OF REFUSE(WASTE) FROM THAILAND

BREAKDOWN BY COUNTRY



EXPORT OF TAPIOCA PRODUCTS FROM BRAZIL



Source: Exports: Trade Statistics of respective countries.

The figures in this table are self-explanatory. Next to Thailand, though by an extremely wide margin, Malaysia seems to have the most export oriented tapioca production among the major exporting countries. The principal export sources of animal feed tapioca products (broken roots, chips, pellets and tapioca meal) are Thailand, Brazil, Indonesia, Mainland China, Madagascar, Angola, Tanzania and Malawi. On the other hand the principal markets for these products are in Europe, the European Economic Community being the most important.

The 1967 exports of tapioca starch from principal exporting to principal importing countries are shown in the following table (in metric tons):

Importing Country / Exporting Country	U.S.	U.K.	Canada	France	Japan	Total
Thailand	116,906		3,903	579	54,494	175,882
Brazil	18,437		2,801			21,238
Taiwan	1,706					1,706
ainland China				1,550	1,296	2,846
Togo				1,321		1,321
Malaysia	172	7,420	254			7,846
S'pore		1,683				1,683
U.S.			2,170*			2,170
Total	137,221	9,103	9,128	3,450	55,790	214,692

*Mostly re-exported

Source: Compiled from "The Market for Starch in Selected Industrial Countries" UNCTAD/GATT, April 1969.

It is obvious from this table that Thailand is by far the largest tapioca starch exporting country in the world followed by Brazil.

Imports

The largest importers of tapioca products in general are U.S.A., the EEC Countries, U.K. and Japan.

a. U.S. Imports

During the last 20 years consumption of starches in the U.S. has trended irregularly upward. The present annual consumption of all starch products is about 3 million metric tons. The rising use of starches is the result of population growth, new applications for the commodity, and the growth of certain industries, particularly the paper industry.

There has been a marked increase in the U.S. annual imports of tapioca and cassava products over the years 1962 to 1965. However, imports have declined since 1965 as shown in the following table:

Imports of Tapioca & Cassava into the U.S.

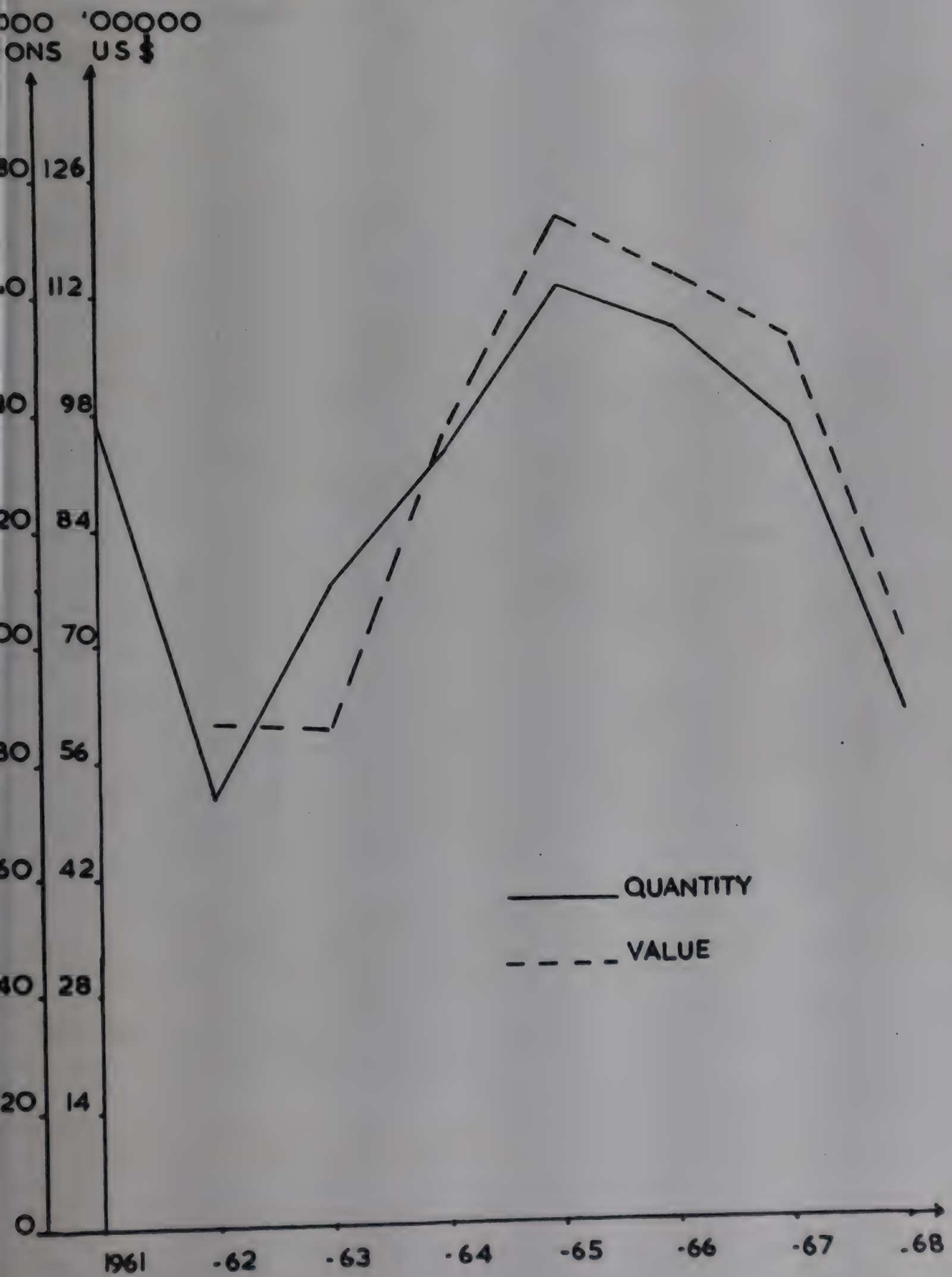
	Quantity in tons	Value 1,000 US$
1962	74,048	6,040
1963	110,875	5,998
1964	133,546	9,566
1965	162,397	12,195
1966	154,536	11,461
1967	137,927	10,686
1968	87,913	7,059

These imports were supplied by many countries. Thailand, the leading supplier, exported an average of more than 117,000 metric tons a year, 72% of the U.S. imports in 1965 and 85% in 1967. The share of Brazil, the next most important supplier declined from 25% to 13%.

Source: Bureau of the Census Report FT 110; FT 125; FT 135.

Most of the tapioca products imported by the U.S. is in the

US IMPORT OF CASSAVA FLOUR AND STARCH



form of starch. Tapioca starch comprises about 4% of all commercial starch consumed in the U.S. Almost all the rest (93%) is in the form of maize starch.

b. EEC Imports

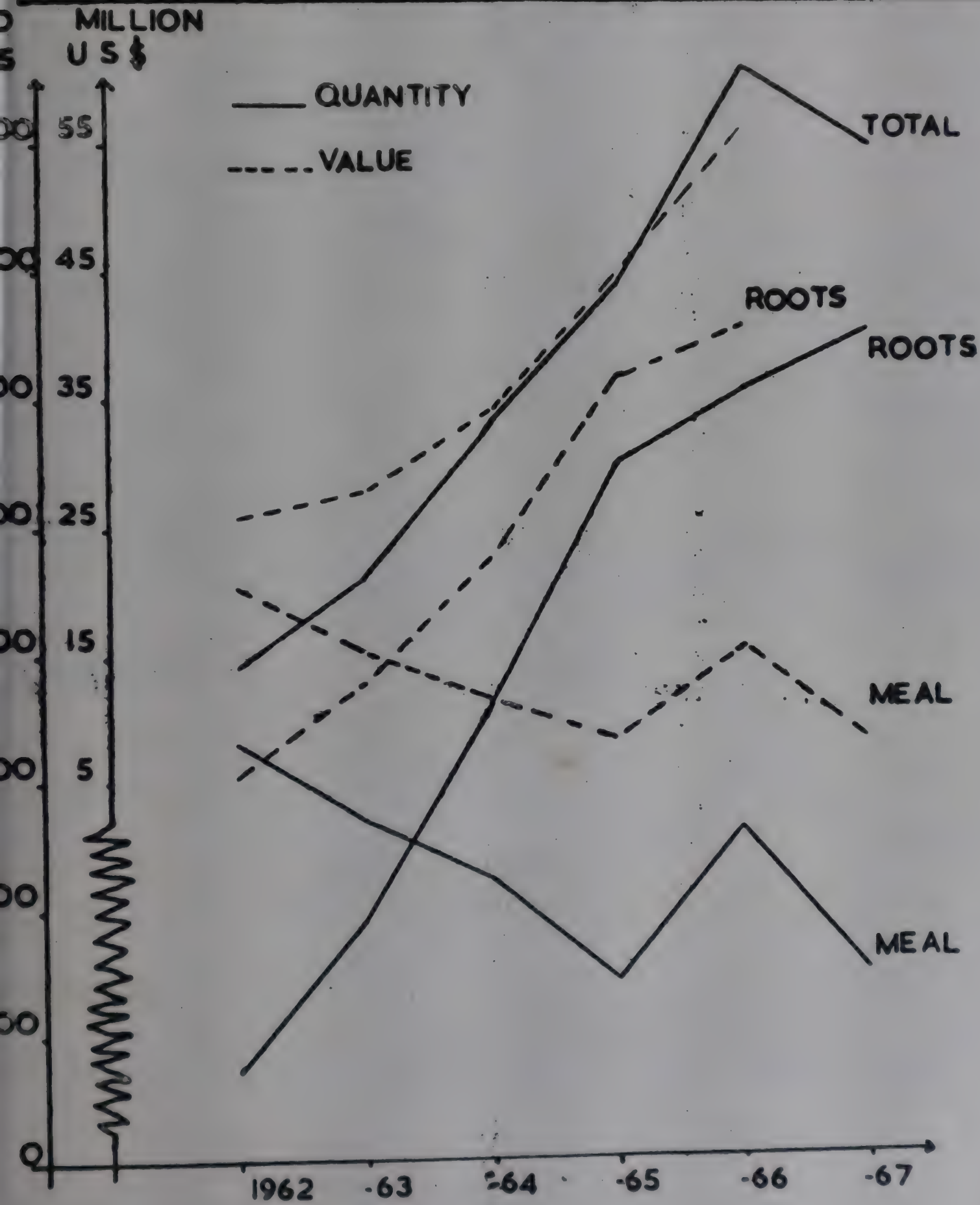
The international demand for tapioca products as feed ingredients (broken roots, chips, pellets and meal) is concentrated in Western Europe. The EEC, in particular, is the largest outlet for exporting countries. Imports of animal feed tapioca products by the EEC have steadily increased and reached 880,000 tons in 1966, more than double the volume recorded in 1962, though imports have slightly declined in 1967 to about 800,000 tons.

The major tapioca importing countries in the EEC over the years 1962 to 1967 are: Germany (which is by far the largest importer), Belgium, the Netherlands and France, in this order. However the Netherlands has been increasing its imports consistently during the specified period. In 1966 and 1967 its imports have exceeded those of Belgium by a considerable margin. The following table shows total imports of these EEC countries from 1962 to 1967 in thousand metric tons.

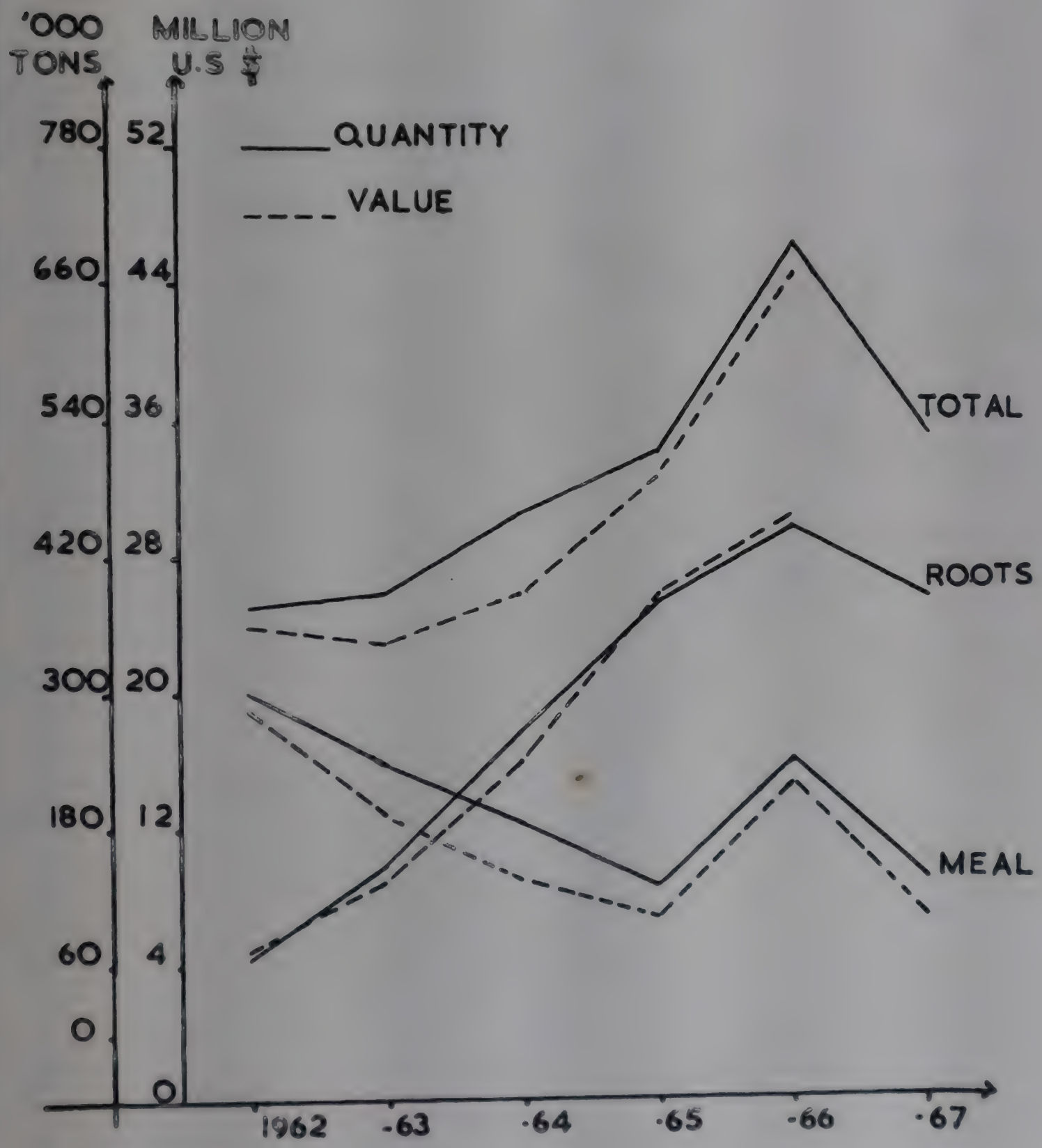
	1962	1963	1964	1965	1966	1967
Germany	366.1	387.3	461.5	519.6	701.7	496.7
Belgium	23.0	72.1	105.4	100.2	70.6	113.3
The Netherlands	1.2	4.7	17.0	76.5	95.5	158.8
France	23.4	19.6	18.0	17.4	15.6	n.a.

Sources: (1) National Trade Statistics for respective countries
(2) EEC Commerce Exterieur 1967

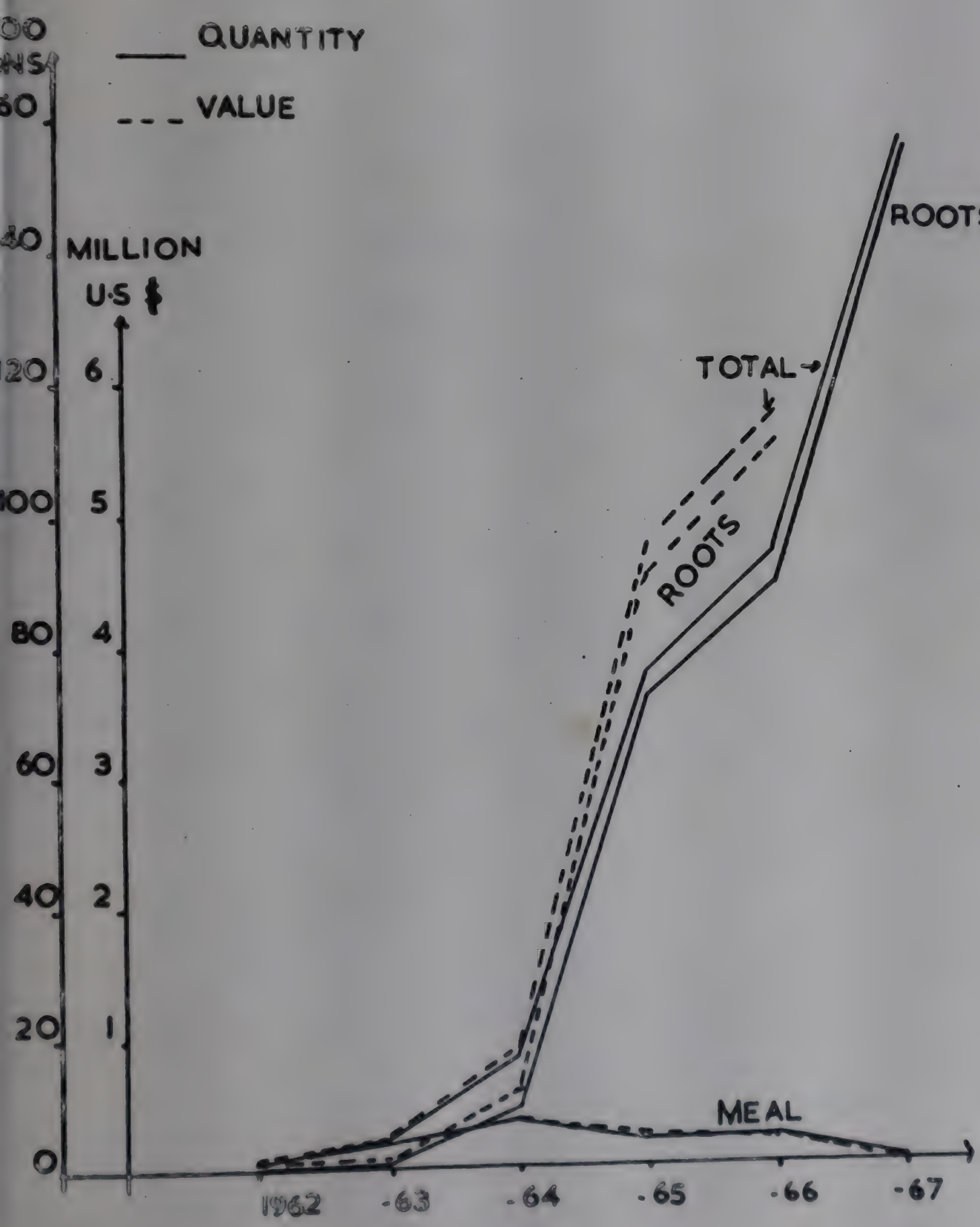
IMPORTS OF MANIOC PRODUCTS INTO THE EEC - TOTAL (BELGIUM, W.GERMANY AND NETHERLANDS)



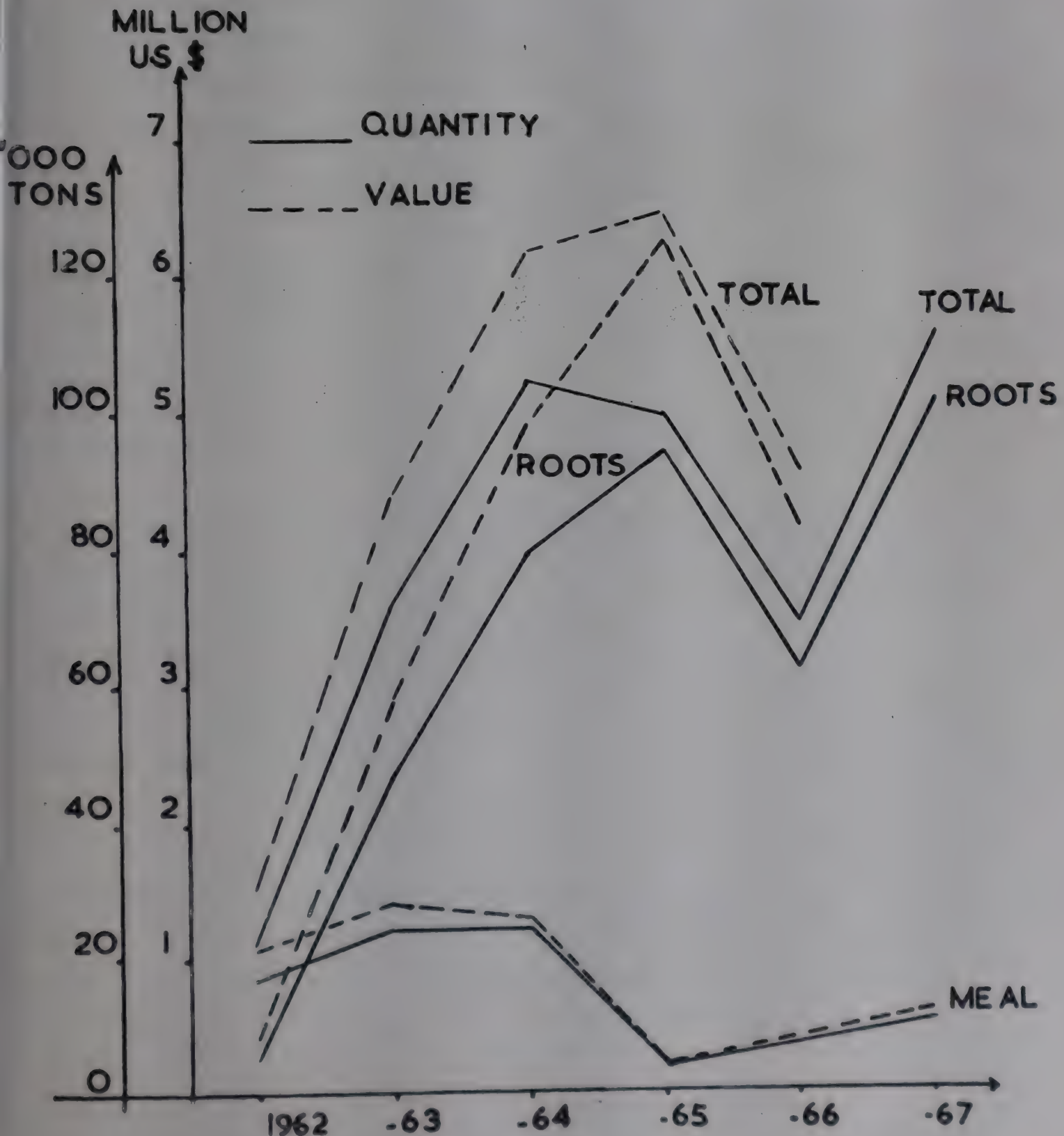
IMPORTS OF MANIOC PRODUCTS INTO THE E.E.C-GERMANY



IMPORTS OF MANIOC RODUCTS INTO THE E.E.C - NETHERLANDS



IMPORTS OF MANIOC PRODUCTS INTO THE EEC - BELGIUM



All tapioca imports to these countries have been in the form of ed roots and tapioca meal with a gradual but definite shift from latter to the former especially in the case of Germany and more of The Netherlands. This would obviously point at the expanding ket for tapioca chips in these two countries due to an expanding estock/meat industry and/or strong trend toward substituting ioca chips for other feed bulk ingredients like feed grains ecially corn (maize).

Dried tapioca roots are supplied to the EEC Countries mainly Thailand, Indonesia, Angola, Tanzania and Mainland China. The re of these major exporting countries in the EEC imports of ed roots in 1967 were as follows:

	Germany	The Netherlands	Belgium
	%	%	%
iland	63.8	69.3	-
onesia	20.1	18.2	45.1
ola	6.0	-	-
zania	4.7	-	-
nland China	0.2	9.0	37.1

The extent to which tapioca may be substituted for feed ains depends, in general, on price relationships and is limited nutritional physiological considerations.

Tapioca imports of the EEC Countries are in particular, fluenced by three major factors: domestic crop of feed grains, ces and availability of tapioca and the Common Agricultural icy of the EEC. In 1967 the European grain crop was generally od. Tapioca prices were slightly down. Under the Common ricultural Policy new import levies on dried tapioca were intro- ced. As import levies at present are higher than the previously arged import duties, the difference in prices between tapioca l feed grains is narrowing. Thus imports slowed down after

July '67 in the German market which caused an overall reduction in imports in EEC Countries in 1967. However, the import levies on dried tapioca roots, which are close to 10% of the customs value, has been set at 6% since January '68. This coupled with the announcement of higher common grain prices for the crop year 1968/69, would favour tapioca products, particularly dried tapioca. This trend should continue in the near future. Imports of tapioca meal and flour, however, will remain stagnant or may even decline*.

c. U.K. Imports

The United Kingdom is a very important market for imported starches. Imports of sago starch were more than 12,000 metric tons in 1965 and '66 but fell to 9,683 tons in 1967. Most of these imports came from Malaysia. It should be mentioned that, since most of the starch imported by U.K. is used in food preparation rather than in industry, imports are not likely to expand in the foreseeable future.

d. Japan Imports

In Japan, imports of tapioca starch increased very rapidly from 16,940 m. tons in '65 to 55,790 m. tons in '67. Nearly all of the imports came from Thailand.

e. Canada Imports

In Canada, tapioca and sago starch imports have increased from 4,397 m.tons in '65 to 9,130 m.tons in 1967. Most of its imports came from Thailand and Brazil and the U.S. (presumably reexported).

. Prices and Freight Rates

. Prices

Prices of Thai tapioca chips are considered as setting the tone of the market. They will vary according to the type of tapioca product and means of transportation (bags or bulk).

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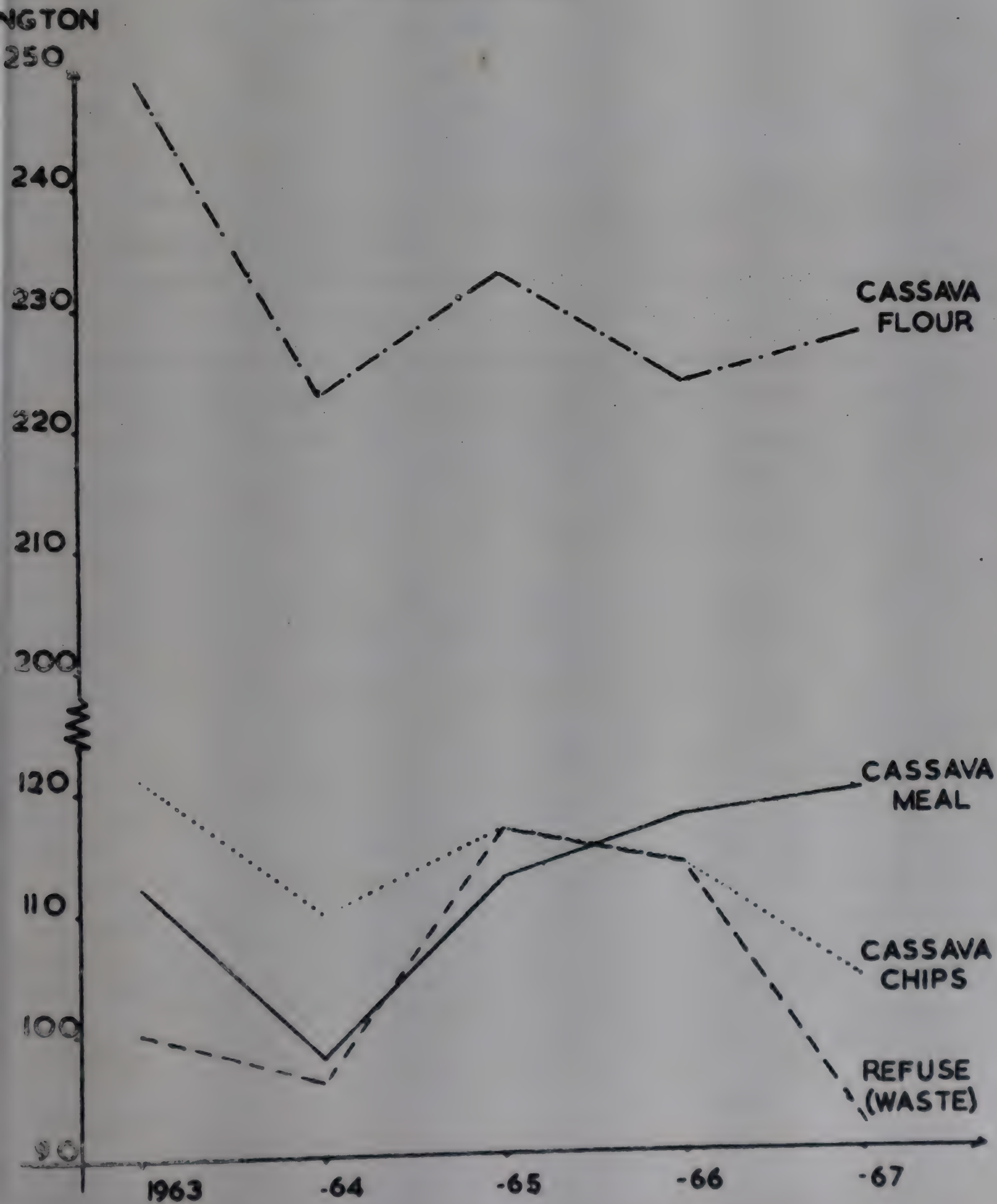
* "The Market, for Manioc". UNCTAD/GATT, Geneva, 1968.

F.O.B PRICES OF EXPORTED APIOCA PRODUCTS FROM THAILAND

M$/LONGTON



The average price of tapioca chips in bags in the EEC market was £27 to £28 per long ton in July 1966. It fell to £23 in July 1967 and then to less than £21 in November 1967. This decline can be attributed partly to the fall in the price of barley in Germany caused by the introduction of common grain prices and import levies on tapioca chips in the EEC in July '67, tapioca being treated as a substitute for barley or maize. Since the feeding value of tapioca is slightly inferior to that of barley and maize, there must be a certain price discount for tapioca.

Pellets are generally the most expensive form, about £1 to £2 per long ton more than chips.

Immediately after devaluation of the £ sterling in November 1967, c.i.f. prices of tapioca products rose by 15 to 16% in sterling terms. This meant a net price increase since the rate of devaluation was 14.3%. However, c.i.f. prices then fell and in December '67 were only 10 to 11% higher than before devaluation. High grain prices might be the most important factor in making tapioca products competitive with other grains, particularly barley and maize.

The following table shows a comparison in prices of barley, maize and tapioca products imported by EEC in September '67

(in units of account* per 100 kgs.)

	C.i.f. price	Import Levies	Prices after levies paid	Difference Compared with barley	Difference Compared with maize
Barley	59.65	30.65	89.00		
Maize	57.25	31.03	88.28		
Tapioca chips	61.60	5.52	67.12	-21.88	-21.16
Tapioca pellets	64.40	5.52	69.92	-19.08	-18.36
Tapioca meal	56.00	8.02	64.02	-24.98	-23.26

* one unit of account is roughly equivalent to US$1

Source: The Market for Manioc. UNCTAD-GATT Geneva 1968

The EEC grain prices for the crop year 68/69 were such that the basic prices for barley and maize have increased by 3.20 u.a. (unit of account) and 4.30 u.a. per ton respectively. This would favour the tapioca products if their prices remained constant.

2. Freight Rates

Freight rates are very important in the tapioca trade as they represent a substantial part of the c.i.f. price. The Far Eastern Freight Conference rates for Thai tapioca exported to Europe at present are as follows:

Product	F. Rate US$/L.ton
Pellets in bulk	12.70
Pellets in bags	13.72
Meal in bags	13.97
Chips in bulk	19.30
Chips in bags	19.05
Waste in bags	15.29
Flour in bags	31.50

Note: (1) Freight rate for flour only has been increased since 1st December 1969 to US$35.50 per L.ton.

(2) In the case of flour only, a 10% Suez charge, reduced to 7.5% as of 1st December, '69, is added to freight rate. However a 10% rebate is paid back to the shipper later if he does not turn to non-conference vessels.

Shipments of tapioca pellets in bulk command the lowest rates. Moreover, bulk cargo is preferred by most users in Europe in view of the poor conditions prevailing in the transport of tapioca products in bags in addition to the reduced cost of bulk handling and inland transport.

The above freight rates for tapioca exports from Thailand may be compared with the following Conference freight rates for

tapioca products exported from Malaysian ports (in US$/L.ton):

Before 1st December 1969

Product	F. Rate	+	10% Suez	-	10% Rebate
Pellets in bags/bulk	16.20		17.82		16.20
Meal in bags	21.20		23.32		21.20
Chips in bags/bulk	27.00		29.70		27.00
Flour in bags	30.07		33.08		30.07
Pearl in bags	39.45		43.40		39.45
Flake in bags	51.30		56.43		51.30
Granulated in bags	39.45		43.40		39.45
Roots in bags	57.35		63.09		57.35

After 1st December 1969

Product	F.Rate	+	7.5% Suez	-	10% Rebate	Increase over Thai Rates %
Pellets in bags/bulk	17.65		18.97		17.20	30
Meal in bags	23.10		24.83		22.52	61
Chips in bags/ bulk	29.45		31.65		28.70	50
Flour in bags	34.15		36.71		33.29	
Pearl in bags	43.00		46.23		41.93	
Flake in bags	55.90		59.09		53.50	
Granulated in bags	43.00		46.23		41.93	
Roots in bags	62.50		67.19		60.94	

Source: The East Asiatic Co. Ltd., K.L.

The much larger quantity of tapioca products exported from Thailand than from Malaysia and the consequent competition among shipping companies to carry Thai products, are the main reasons for the substantially higher freight rates of Malaysian exports, except for tapioca flour.

D. Uses

Tapioca products are used for human food consumption, in various industries requiring the use of starch and as an ingredient in animal feed compound. Generally speaking these three major uses of tapioca products are allocated among the three major world markets as follows:

U.K.: most of the starch used in U.K. (66%) goes to food industries.

U.S.: the principal uses of tapioca starch in the U.S. are in making paper, adhesive and textiles and food products.

EEC.: most of the tapioca products are used by EEC feed mills in manufacturing the compound feeding stuffs.

1. Tapioca starch for industry

All starches are, to a greater or lesser extent, inter-changeable for many uses. For some uses (e.g. wheat starch for paper hanging) the properties and characteristics of a particular starch make it especially suitable and users would be reluctant to substitute other starches even when these are lower in price. In other applications, price will be the main consideration.

Tapioca starch is used extensively in the textile and paper industries and for making tapioca dextrin. This dextrin is used as an adhesive on postage and other stamps, gummed envelopes and tape. Tapioca starch is also used to make plywood and veneer adhesives and in laundries. It produces gels of clarity and flexibility, and, since it has no cereal flavour, it can be used directly for thickening foodstuffs.

2. Tapioca products for animal feed

Tapioca products (dried roots and meal) have long been known as raw materials for compound feed stuff. It was extensively used before the second World War. After 1947, grains became cheaper than

tapioca products in Europe, and German tapioca imports were regulated by the Government until 1958, so that its use declined considerably. However, the Common Agricultural Policy of the Europen Economic Community, introduced in 1962, raised the price of feed grains and the German and later the Dutch and Belgium manufacturers again used tapioca product extensively.

There is a variety of tapioca products used as raw material for the compound feed-stuff industry. These are broken roots, chips which is the most widely used product, pellets, slices and meal. At present tapioca pellets are gradually but significantly gaining popularity among animal feed manufacturers in the EEC countries.

Pellet manufacturers use, as a raw material, tapioca chips as they are produced in Malaysia, i.e., slicing roots, dry them on a cement floor for approximately 24 hours until moisture content is brought down to approx. 12%. Tapioca pellets are obtained from dried chips and broken roots by grinding and hardening into the cylindrical shape. These pellets are less then 1 cm. in diameter and about 2 cm. in length. Pelletizing requires a large amount of investment in plant and equipment, and at present, pellets are only produced in Thailand.*

In manufacturing pellets peeling the roots is not compulsory.

Tapioca as a feed ingredient is principally a fattening agent. As a result, it is mostly used for pigs. It is very good for finisher pigs and reproductive sows but it is less used for piglets where protein for body-building is more important than forming fat. However, the use of tapioca is limited by the fact that pork meat from lean and meagre pigs is now considered better in quality.

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* It has recently been learnt that a pelletizing machinery was brought into Malaysia by a Danish Company to be used for producing pellets at Kuantan.

There are two principal raw materials competing with tapioca in compound feeding-stuff production. These are barley and maize which have practically the same analytical characteristics as tapioca although maize is superior in feeding value since it contains more protein and fat. Since the introduction of the Common Agric. Policy which raized prices of feed grains, the compound feed-stuff industries of EEC countries have been trying to reduce costs and are looking for substitute raw materials. Thus, almost all manufacturers now use tapioca which began to recover its market in Germany in 1958, in Belgium in 1963 and in the Netherlands in 1965 because of favourable prices. At present, it faces competition from barley in Germany and maize in the Netherlands and Belgium.

The majority of the large manufacturers of compound animal-feed in the Europeon Countries are now equipped with electronic computers to determine the composition of the compound feed stuffs. They take two important factors into consideration-feeding values and prices. In grain producing countries, the major factor determining composition of feed is, generally, the pattern of local grain production. For instance, in the EEC countries the new barley crop is mainly used between August and October when prices are lower than during the later months; the size of the annual crop, then, will affect the use of competing raw materials like tapioca.

If tapioca prices are competitive, there should still be scope for an increase in tapioca consumption, especially in the Netherlands and in Belgium. By contrast with the grain producing countries, where countries rely on imports for a sizeable portion of their requirements, relative prices of imported animal feed ingredients are major additional factors determining the composition of feeding stuffs.

Consumption trend in EEC Countries

Total consumption of animal feed depends upon two factors, the livestock number and the consumption per animal. On the whole livestock number has not increased significantly in the major EEC countries between 1962 and 1966 as shown in the following table:

Increase of livestock in the 3 EEC Countries (1962/66)

	Germany	The Netherlands	Belgium
Cattle	3.0%	8.8%	-2.4%
Pigs	0.5%	46.5%	6.4%
Poultry	22.7%	-0.7%	-16.6%

Source: "The Markets for Manioc". UNCTAD/GATT, Geneva, 1968.

However, the consumption per animal has been continually increasing as modernization of feeding methods has developed. Rates of increase between 1963 and 1965 are shown below:

Increase of consumption of compound feed stuff per head (1963/1965)

	Germany	The Netherlands	Belgium
All cattle	30.0%	4.4%	17.0%
Milk cows	33.5%	8.7%	18.9%
Pigs	28.0%	-5.3%	11.1%
Pigs (slaughter)	23.7%	2.9%	19.7%
Poultry	13.3%	-4.5%	47.6%

Source: "The Markets for Manioc". ibid

These figures reflect exactly the stages of development in the use of compound feed stuff. In the Netherlands the most advanced in this field, rates of increase are small, and there is even a decline in some uses; saturation point may have been reached. However, in Germany and Belgium , growth rates are very high and this will continue for some time before consumption per head reaches the present Dutch level.

Quality Considerations

The standards for, or the attitude towards, the quality of tapioca products for animal feed differs in the importing countries. German manufacturers, the largest consumers, do not so far stress this point. Dutch and Belgium manufacturers are more quality minded. The standard of quality for tapioca products are generally based on (1) starch content (minimum) (2) moisture content (maximum) (3) raw-fibre content (maximum) (4) ash (or sand) content (maximum)

One of the most important factors affecting quality is exposing tapioca products to water or moisture during and after processing. This removes the starch, the colour turns brown, black, grey or green and the feeding value deteriorates.

Tapioca chips, which so far have been the most common form in which dried tapioca roots are traded, are ideally well peeled, washed and dried. The chips which are not well peeled are brown in colour, and their raw fibre content is higher.

Production and Processing in the States of West Malaysia.

Perak

The State of Perak is by far the most important tapioca producing state in the whole of Malaysia in terms of production of both roots and tapioca products and also in terms of the magnitude of problems confronting the industry.

Acreage:

According to "Statistical Digest Ministry of Agriculture and Cooperatives, March 1969" and previous issues, the following table represents 1961 to 1968 tapioca acreages in Perak and their percentages of West Malaysia total:

Year	Sole Crop			Mixed Crop			Sole Crop Equivalent		
	Total W.M. acre	Perak acre	% of Total	Total W.M. acre	Perak acre	% of Total	Total W.M. acre	Perak acre	% of Total
1961	22,570	10,130	45.6	17,714	1,790	10.1	31,427	11,025	35.1
1962	37,563	24,718	65.8	18,072	1,740	9.6	46,599	25,588	54.9
1963	47,078	32,845	69.8	17,625	4,580	26.0	55,891	35,135	62.9
1964	35,245	25,740	73.0	20,563	4,070	19.8	45,527	27,775	61.0
1965	30,592	20,880	68.3	19,528	5,850	30.0	40,356	23,805	59.0
1966	26,432	18,770	71.0	19,576	6,335	32.4	36,220	21,938	60.6
1967	34,567	22,665	65.6	20,434	6,122	30.0	44,784	25,726	57.4
1968.	26,502	19,352	73.0	31,124	10,860	34.9	42,064	24,782	58.9

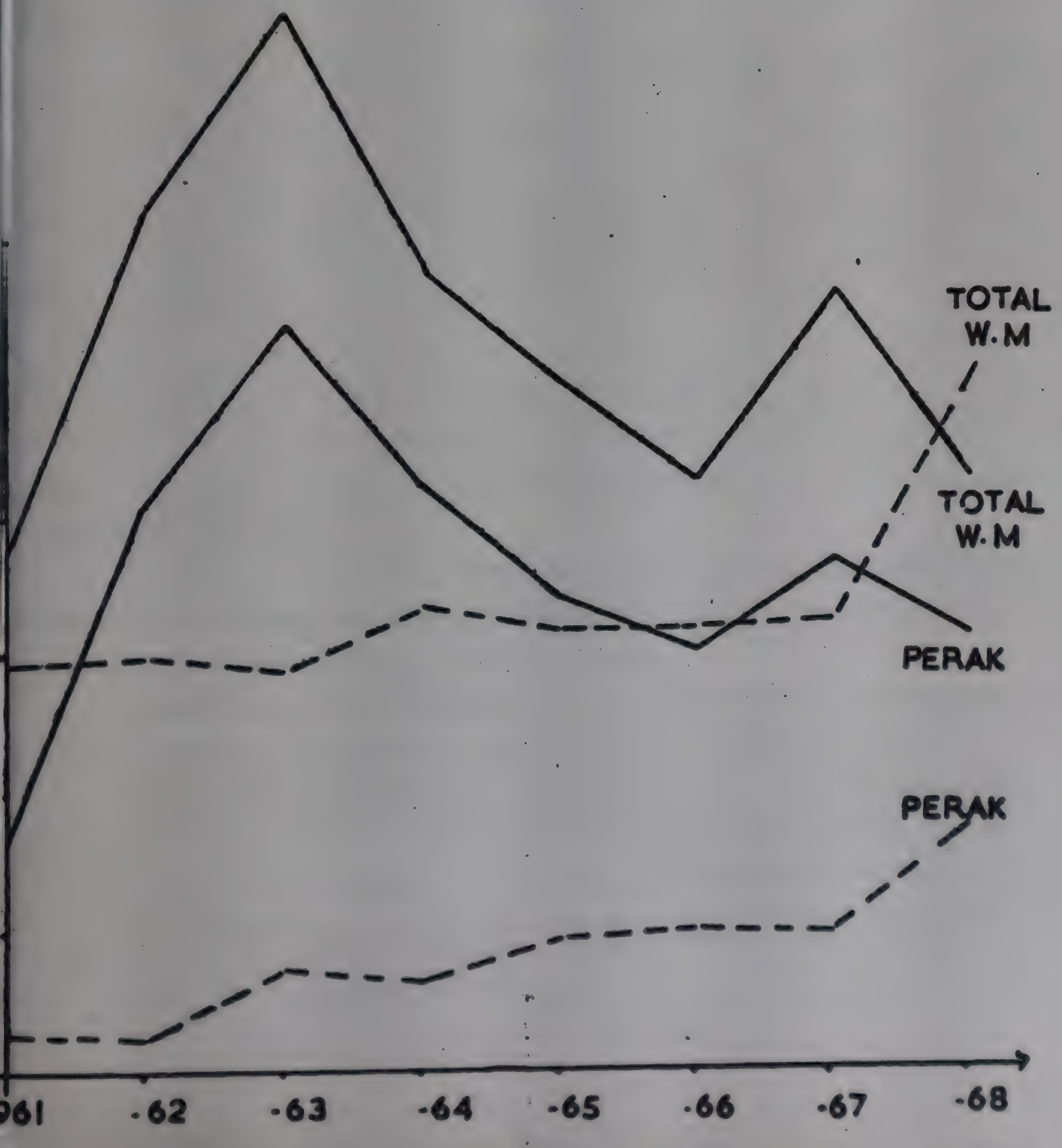
The 1968 acreage is distributed among districts in the following pattern:

TAPIOCA ACREAGE IN PERAK AND W.MALAYSIA TOTAL 1961-68

KEY:

___SOLE CROP

----MIXED CROP



the jungle trees. Other operating cost which may be considerably high is that of transporting the harvested roots to the factory in view of the distance and poor road conditions. The illegal cultivation continuously shifts to other areas after the soil had been exhausted from successive tapioca cropping without applying fertilizer. Because of a favourable cost/price relationship which has been existing until now and in view of the scarcity in land alienated by the state government, especially for tapioca cultivation as a discouragement measure, numerous individuals have been willing to take the risk and pursue their illegal activities.

The harvesting of tapioca roots does not follow a seasonal pattern. It is done throughout the year as long as the plant (or the field) has reached the age of 14 to 16 months. At that age the roots will have reached a desirable size and the starch recovery rate is supposed to be at its highest. This would presumably maximize the total starch recovery per land unit measure given other agronomical and farming practices.

Harvesting is done by hand and if the soil is not too heavy or dry it becomes a relatively easy manual operation. It is learnt that, on the average, a lorry load of 100 piculs (5.8 tons) of roots could be harvested and collected by 4 men working one day for 8 hours, i.e., 32 man/hours. Hence, on the basis of an average yield of 200 piculs/acre for Perak, twice this amount of manual labour is required to harvest one acre on the average.

Processing:

The situation of sago and tapioca processing in Perak in 1967 and its relative importance may be illustrated by the following table:*

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* The actual number of tapioca factories in Perak, based on those reported by the Dept. of Stat. and by the Perak Agricultural Office in addition to those discovered during the field survey was found to be 49 factories: 18 processing starch products and 31 processing chips.

o. of Establish'ts			Gross sales Value			Cost of Materials Purch'd			Salaries & Wages Paid		
otal W.Mal	Perak	% of Tot.	Total W.Mal $'000	Perak $'000	% of Tot.	Total W.Mal $'000	Perak $'000	% of Tot.	Total W.Mal $'000	Perak $'000	% of Tot.
59	30	51	12,777	7,688	60	10,809	6,643	61	839	386	46

Source: Survey of Manufacturing Industries in West Malaysia, 1967. Department of Statistics.

The above figures represent factories which procured their raw material in the form of Cassava roots and semi- processed products thereof and/ or Sago palms or trunks and their semi-processed products. However, the bulk of the raw material intake comes from Cassava rather than Sago palms as has been generally observed in the state of Perak and as evidenced by the following national figures for 1967:

Cost of Raw Material Delivered at Factory for West Malaysia.

Raw Material				Semi - Processed Material			
oca Roots		Sago Palms or Trunks		Wet Tapioca		Wet Sago	
	%	$'000	%	$'000	%	$'000	%
	90.6	655	9.4	1,325	88.1	179	11.9

Source: Survey of Manufacturing Industries; ibid -

Moreover, based on national figures for 1967 quantity and selling value (ex-factory) of all products manufactured from Cassava roots are much larger than those manufactured from sago palms as shown in the following table: -

	Quantity			Selling Value			
a Products		Sago Products		Cassava Products		Sago Products	
ns	%	'000 Tons	%	$'000	%	$'000	%
	73.3	23.6	26.7	8,164	75.5	2,655	24.5

Source: Calculated from: Survey of Manufacturing Industries; ibid

The annual fresh root intake by Perak chip factories varies from 7,000 piculs to 60,000 piculs per factory producing approximately between 2,800 piculs to 24,000 piculs of dried chips. In case of starch factories, the intake of fresh roots vary between 42,000 piculs and 360,000 piculs per factory producing approximately between 7,140 piculs and 61,200 piculs of starch products (see the results of the factories field survey).

Transport: The transport of roots to chip and starch factories is mostly done by lorries provided by either dealers or factory operators. Transport cost naturally depends on distance and road conditions. For legal cultivators where roads are reasonable, charges are generally 25¢ to 40¢ per picul within a distance of 15 to 20 miles. However, for illegal cultivators transport cost can go up as high as 80¢ per picul.

Root Prices: Prices paid to farmers ex-farm depends on: (1) general price level of manufactured product (2) quality of roots and (3) transport charges to factory; in addition, of course, to the prevailing bargaining power between buyer and seller. These prices have been observed to range between $1.70 to $2.50 /pic.

Judgement of quality is made on the basis of soil type and fertility which nullifies the importance of actual inspection of shipment upon arrival at the factory. However, in case where inspection is necessary, an experienced person can judge the expected relative starch recovery by examining the roots with regard to: (1) size and shape (2) colour of skin and (3) colour and appearance of flesh (by breaking one tuber in half by hand).

Quality considerations are, generally, more important for starch than for chip production.

Chips Processing: Chips processing is a simple operation and requires relatively small capital and know-how. The main capital investment items are:

(1) Cutting machine that costs $500 to $600
(2) Cement sun-drying yard
(3) Storage space for roots and chips.

The cutting machine commonly used by manufacturers can slice 60 piculs of roots per hour. However, a machine's operation is limited by the drying space and weather condition. It was observed that, at best, a machine can operate for 5 hours only (in the morning period), thus, slicing an intake of 300 piculs of roots. A drying area of about 1.5 acre would then be needed to dry one machine's output in one to two days depending on the weather. Hence, if the drying took two days, twice as much area would be needed to keep the machine in daily operation. However, since machines are much easier to purchase than land and since they have to work only during the early hours of the day, the machines idle capacities will always be an accepted normal situation until a cheap artificial drying method is developed for the tapioca chips industry.

Under rainy conditions roots may be stored after harvest up to 5-6 days before slicing into chips. However, in this case supply can easily be controlled by adjusting harvesting dates to factory needs.

Chips, which are mostly sold to dealers who distribute them to poultry and pig farmers, fetch a price of about $7.50 per picul. Chips/roots recovery rate is known to be 40%.

The scale of operation among the Perak chips factories was learnt to range between 1 to 4 machines. It was also observed that,

in few cases, starch factories have chips machine on the side in order to utilize the inferior quality tubers and/or excess supply.

Starch Processing: Unlike chips, starch processing requires a considerable amount of capital and technical knowledge. In addition, strict adherence to quality standards of final products is a major long-run survival factor for the industry.

It was generally observed that the machinery and equipment used by almost all of the Perak starch manufacturers were old in type and age and that consequently, the processing method adopted was not conducive to the production of high enough quality starch to meet international standards in competitive markets.*

Perak starch factories produce tapioca flour, seed, pearl and flakes. In addition they produce tapioca refuse (wet and dry) as a by product. The average starch/root recovery is about 16%.

Due to shortage in the overall root supply in addition to bottlenecks in the processing line (mainly the heating kilns' limiting capacity), the average utilized capacity of the starch factories in Perak is said to be about 40% of the overall maximum capacity. Since about 70% of the factories' supply is cultivated illegally, the elimination of this portion would reduce the utilized processing capacity to only 12%. This seems to be the main cause of worry among the factory operators and of their desperate effort to acquire land from the State Government in order to guarantee a minimum supply level of raw material.

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* In addition to actual observation, this statement is based on discussions with starch experts who visited Malaysia a year ago. However, objective verification will have to be made through laboratory analyses in the light of required specifications.

Starch factory output in Perak is mostly exported and to a limited extent sold in the domestic market to the various foods industries that use tapioca starch as an ingredient, in their food mix and to other chemical and non-food industries. In selling to foreign markets, most factories deliver their products to shipping lines.

Starch (flour) price and that of other derivatives vary according to foreign market conditions, but the quoted current price is somewhere between $12 and $13 per picul f.o.b. Penang.

General Problems in Perak

From the foregoing general presentation, the problems confronting the tapioca industry in Perak may be summarized as follows:

(1) The bulk of the raw material supply is illegally produced. If this is being and continues to be economically feasible, it certainly has undesirable social implications.

(2) Faced with the situation outlined in (1), the starch manufacturers operate under high degree of uncertainty. Obviously this situation inhibits any entrepreneurial effort toward the development of the industry in the form of modernization or expansion.

(3) The overall processing capacity of starch factories is considerably greater than the available supply of raw material resulting in a large idle capacity and increase in average processing cost.

(4) Starch processing machinery, equipment and method are old and are not likely to produce high enough quality starch if present foreign markets become more competitive or if new markets are sought.

(5) With the present status of the legal tapioca cultivation which is receiving anything but encouragement from the

State Government, farm practices, production input application and in general farm management decisions and techniques cannot be expected to result in efficient production or soil conservation.

2. Penang and Province Wellesley

The state of Penang is next to Perak in importance in the overall volume of resources engaged in tapioca industry. In addition, it serves as the main port of export for most of tapioca products which are channelled to foreign markets.

Acreage:

According to "Statistical Digest, Ministry of Agriculture and Cooperatives, March 1969" and previous issues, the following table represents 1961 to 1968 tapioca acreages in Penang and Province Wellesley and their percentage of West Malaysia total:

Year	Sole Crop		Mixed Crop		Sole Crop E'valent	
	Penang & P.W. acre	% of Total W.M.	Penang & P.W. acre	% of Total W.M.	Penang & P.W. acre	% of Total W.M.
1961	3,050	13.5	425	2.4	3,263	10.4
1962	2,265	6.0	960	5.3	2,745	5.9
1963	2,217	4.7	610	3.5	2,522	4.5
1964	1,910	5.4	470	2.3	2,145	4.7
1965	1,960	6.4	470	2.4	2,195	5.4
1966	2,243	8.5	650	3.3	2,568	7.1
1967	1,290	3.7	505	2.5	1,542	3.4
1968	480	1.8	1,120	3.6	1,040	2.5

The 1968 acreage is distributed among districts in the following pattern:

District	Sole Crop		Mixed Crop		Sole Crop E'valent	
	acre	% of State	acre	% of State	acre	% of State
B'worth/ North	450	93.7	425	37.9	663	63.7
Bt.Mertaj./ Central	-	-	420	37.5	210	20.2
Nibong Tebal /South	30	6.3	255	22.8	157	15.1
Penang/N.E.	-	-	12	1.1	6	0.6
Balik P.Pg. /S.W.	-	-	8	0.7	4	0.4
Total	480	100.0	1,120	100.0	1,040	100.0

Source: "Acreages of Miscellaneous Crops in 1968, Ministry of Agriculture and Cooperatives, July 1969".

Cultivation: The status of tapioca cultivation in Penang and Province Wellesley is completely different from that in Perak. In Penang tapioca is considered like any other crop and may be grown by any farmer anywhere in the state at any time with no special licence required or additional tax paid. Therefore, no illegal cultivation exists and consequently the published acreage has been confirmed by the local agricultural officers. The yield per acre for the state ranges between 100 to 200 piculs. Though some of the farms visited have reported using fertilizer, the yield has been steadily declining since land was first planted with tapioca. The problem of fertilizing such an exhaustive crop like tapioca has not yet gained the attention of research bodies or experiment stations; it has so far been left to the farmer's guessing trial and error.

Processing: The situation of sago and tapioca processing is Penang and Province Wellesley in 1967 and its relative importance may be illustrated by the following table:

No.of Establish'ts			Gross Sales Value			Cost of Materials Purchased			Salaries & Wages Paid		
Total W.M.	Pg. & P.W.	% of Total	Total W.M. $'000	Pg. & P.W.	% of Total	Total W.M. $'000	Pg. & P.W. $'000	% of Total	Total W.M. $'000	Pg. & P.W.	% of Total
59	6	10	12777	2776	22	10809	2372	22	839	224	27

Source: Survey of Manufacturing Industries in West Malaysia, 1967. Department of Statistics.

While the average gross sales value per factory in Perak was $256,000 (see table in section on Perak) the corresponding figure for Penang and Province Wellesley is $463,000 which shows that Penang factories are considerably larger, on the average, than those of Perak. Moreover, the quantity of raw material (tapioca roots) purchased by the Penang factories is considerably greater than what the acreage in the state can provide. The balance, as learnt from the manufacturers in Penang, is procured from North Perak and Kedah farms. The importance of Penang as more of a tapioca processing than root producing state may be revealed from the following comparison with Perak (based on previously tabulated 1968 acreage and 1967 processing figures):-

	Perak		Penang
Sole Crop acreage as % of W. Malaysia	73.0%		1.8%
Ratio Perak/Penang		40.6:1	

	Perak		Penang
Sole Crop equivalent acreage as % of W. Malaysia	58.9%		2.5%
Ratio Perak/Penang		23.6:1	
Cost of Material Purchased by factories as % of W. Malaysia	61%		22%
Ratio Perak/Penang		2.8:1	

Note: (1) On national basis the value of raw material, i.e., tapioca roots and sago palms and trunks constitutes 64% of total value of purchases by factories in 1967.

(2) As previously shown the sago portion in the raw material used is practically negligable compared with that of tapioca.

Tapioca processing in Penang is carried out by 7 factories ranging in capacity between 2 tons to 10 tons of flour and other starch products per day. All of the large factories are located in Province Wellesley central district.

In addition to supply from the state's own land, a large portion of the root intake comes from North Perak and to a small extent from Kedah. Starch factories seem to encounter great difficulty in bringing tapioca roots from the illegal fields of Perak deep in the jungle. Careful planning of transport and contacts has to be made in order to bring the roots to the factories not much later than 3 days after harvest before starch contents undergo unfavourable changes.

The problem of engineering and technological bottlenecks existing in starch processing factories was clearly observed. Drying space (kilns) limits the utilized capacities of other processing components to 8 hours per day. One of the largest starch factories

in the state actually utilizes its maximum technical capacity producing 8 to 10 tons of starch per day but only on the basis of 8 hours daily operation for most of its machineries and equipment. Under prevailing processing technology it is learned that, given a raw material quality, root crushing stage is the most important processing determinant of starch recovery.

Primitive methods of processing are carried out on the farm by some tapioca growers. For those who have a livestock enterprise, especially pigs, they find it more profitable to extract starch by primitive methods and sell it in a semi-wet form to starch factories at about $3.50 per picul for further processing (cleaning, drying, etc.). The "refuse", which is a by-product of this operation, is then fed to livestock.

Note: Certain information presented in the section on Perak was not restated in this section as no significant difference between the two states with regard to this information was observed. On the other hand, not all the information presented here is characteristic to Penang only. It also serves as a complement to the sluggish information channel encountered during the Perak field trip.

General Problems in Penang and Province Wellesley

Compared to Perak, the tapioca industry in Penang has, virtually, no problems. However, problems of long-run nature which have been observed may be summarized as follows:

(1) Complete lack of extension assistance to tapioca farmers.
(2) General technological under-development of the starch processing factories.
(3) Uncertainty of raw material supply and high cost of transport thereof.

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3. Johore

Tapioca cultivation in Johore seems to be of minor importance at least at the present time. This is indicated by the large portion of mixed crop acreage compared with that of the sole crop acreage which were for 1968: 4660 acres and 565 acres respectively.* Moreover, this acreage is scattered all over the state with no obvious regional concentration as shown in the following district distribution pattern:

District	Sole Crop acres	Mixed crop acres
Batu Pahat	100	700
Johore Bahru	225	344
Kluang	-	903
Kota Tinggi	180	550
Mersing	-	87
Muar	-	1,375
Pontian	60	189
Segamat	-	513
Total	565	4,660

It is, therefore, quite likely that a considerable portion of the tapioca acreage in Johore is devoted to sweet varieties for fresh human consumption rather than bitter variety for industrial processing.

On the other hand, the published statistics on tapioca and

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* Acreages of Miscellaneous Crops in 1968, Ministry of Agriculture and Cooperatives, July 1969.

sago processing in Johore show a different picture. In terms of number of establishments, Johore comes next to Perak with 17 factories; but apparently these factories are, on the average, quite small compared with those of Perak and Penang as evidenced from the following average gross sales value in 1967 for the three states.

Average gross sales value per factory

	$ '000
Perak	256
Penang	463
Johore	80

Starch industry utilizing tapioca as raw material is, as learned from local officers, practically non-existent in Johore. Seemingly, the starch factories included in the 17 tapioca and sago establishments listed for Johore, manufacture most of their starch from sago palms and trunks rather than tapioca roots. These are mostly located in Batu Pahat and Muar districts. Inevitably, since starch factories can utilize sago or tapioca interchangeably as raw material, relatively large concentration of tapioca cultivation is found in these districts as may be observed from a previous table.

The state of Johore has been observed to be a potentially important tapioca expansion area. Though the state government has not been encouraging tapioca cultivation, a significant change in attitude in favour of tapioca cultivation has recently been observed. The switch in thinking has been furthered by certain current actions. The state government, through revenue collectors, is surveying the acreages of expiring mining leases for intended alienation for tapioca cultivation. Moreover, the state government has recently (November '68) alienated 6000 acres of virgin jungle to five private concerns, in addition to FLDA, each a 1000-acre block, for planting tapioca. This acreage is located in Mukim Masai in Johore Bahru District.

A premium of $30 per acre* was paid in addition to an annual rent of $6 per acre for the duration of the 25-year lease. The alienation of this land was conditioned by an agreement that a small tapioca factory should be constructed within two years (FLDA excluded) subject to later alteration in order to speed up the land development processes. In fact it is learned that all parties acquiring this land had serious intentions. One company has already felled more than 500 acres and a starch factory is planned to be established for the whole area.

The great demand for land for tapioca cultivation in Johore is evidenced by the fact that 37 applications were submitted to the state government (18 companies and 19 individuals) of which only 5 were selected. But, of course, the pressure on land by private investors is generally great, and in this case, tapioca happened to be a condition for land alienation.

Potential future expansion in tapioca cultivation in Johore would likely be within the following areas:

Area	Acreage
Pengerang in Kota Tinggi District	10 - 15,000 acres
Segamat and Kluang Districts: up to	20,000 acres
Total: up to 30 to 35,000 acres.	

Tapioca has been recently planted (sole and inter cropped) in certain rubber and oil palm estates for processing into chips. These estates are mainly located in Kluang District. A one-machine chip factory is operated by one of the estates and supplied from the whole area's harvest. Average crop yield is about 150 piculs per acre. Root price ex-factory is $2.10 per picul or $1.40 per

*A premium for alienated land in Johore ranges between $30 and $50 per acre which shows a sign of encouragement given by the state government to tapioca cultivation.

picul ex-farm and excluding harvesting cost. Chips are sold to Malacca, Kuala Lumpur and Singapore at $7 to $8 per picul ex-factory. They are also sold to dealers who mix them with other feed ingredients and sell the mixture to pig and poultry farmers.

4. Perlis

Tapioca cultivation is practically non existent in Perlis. According to "Acreages of Miscellaneous Crops in 1968" there are only 70 acres of sole crop and 50 acres of mixed crop. This acreage is cultivated by smallholders in sandy loam soil and represents both sweet and bitter varieties. No tapioca processing factories of any type exist in Perlis.

Expansion potentialities: Fringe alienation schemes, which come under the State Commissioner of Land and Mines are the only land alienation schemes existing at present. There are however, 45,000 acres of forest (jungle) and 23,000 acres of scrap forest (secondary jungle) which have not yet been alienated. Half of these areas are illegally occupied and are likely to remain so. The other half i.e, 34,000 acres, which is situated in the middle and mid-eastern part of the state could, therefore, be alienated for cultivation in which case tapioca would stand a chance if economically desirable. The soil of roughly half of this acreage belongs to class 2 fertility and that of the other half belongs to class 3. Climatic conditions in general are not unsuitable for growing tapioca. In fact, it was learnt from local officials that tapioca cultivation was suggested by a Japanese Professor employed by the federal government a few years ago to evaluate agricultural potentialities. The eastern part next to the Thai border was mentioned as a suitable area for that purpose.

5. Kedah

Area planted tapioca in 1968 was 995 acres as sole crop and 596 acres as mixed crop (Acreages of Miscellaneous Crops in 1968). This acreage, which is planted entirely by smallholders mostly in sandy loam soil, represents sweet as well as bitter varieties. Concentration of sole crop cultivation is found in Kuala Muda and Sik districts with acreages of

612 and 294 acres respectively. The state average yield is estimated at 150 piculs per acre. The state government of Kedah neither provides incentives nor imposes speical restrictions for tapioca growing.

Four starch factories are situated in South Kedah; and since there are no chip factories in the state; tapioca roots harvested are channelled either for home consumption or for starch processing.

Expansion potentialities: State land available for cultivation but as yet has not been alienated is distributed among the various districts as follows

District	Acres
Padang Terap	10,000
Kubang Pasu	7,000
Kota Star	3,000
Sik	6,500
Total	26,500

This acreage which consists of all soil types and which is, consequently suited for growing a variety of crops, has all been applied for at the land office. The 7,000 acres of Kubang Pasu are likely to be alienated to a FLDA scheme. Tapioca, would, therefore have to compete with other crops for the remaining acreage. The competition might not likely be in favour of tapioca growing as attention and incentives are still being given to padi, rubber and oil palm cultivation.

6. Selangor

Cultivation of tapioca in the state of Selangor, which is carried out entirely by smallholders is confined to the sweet variety. This apparently is due to the proximity of the growing areas to large population centres and also to the absence of any processing plants in the state. The 1966 acreage of tapioca in

the state of Selangor is reported by the "Acreages of Miscellaneous Crops in 1968" as 1,090 acres and 2,635 acres as sole crop and mixed crop respectively. Though no incentives of any form are being provided for growing tapioca, attention at the Federal level has been shown toward the agronomical improvement of this crop*

Expansion potentialities: About 240,000 acres including 70,000 acres of forest reserve, are suitable for crop cultivation. Excluding the forest reserve area, which is not feasible to convert into agricultural land, the remaining 170,000 acres represent state land all of which is virgin jungle. Most of this area would require elaborate drainage system before cultivation as it is water logged mostly peat soil.** Large capital investment would, therefore be required to alienate this area for crop production. Whether or not tapioca would have a chance to capture a share in this area would depend upon market conditions for tapioca products relative to those for products of other crops competing for land in addition to relative production and processing efficiency.

Negri Sembilan

Tapioca cultivation in N.S. is of minor importance. In 1968 total tapioca acreage of sweet and bitter varieties was 350 acres of sole crop and 1171 acres of mixed crop. Port Dickson district, being the main pig raising area in the state, had the largest tapioca acreage: all of the 350 acres of sole crop and 500 acres of mixed crop. Most of the tapioca acreage occupied class 2 fertility soil yielding 9-10 tons of root per acre.

* The Federal Experiment Station at Serdang has been conducting various experiments on tapioca. See: Chan Seak Khen, "Tapioca Investigations at the Federal Exp.Sta., Serdang, October 1969

** Experiments on growing tapioca in peat soil and fertilizers requirements have recently been conducted. See Chew Wee Yong et-al "Effect of NPK Fertilizers on Tapioca Grown in Peat" Dept. of Agric., K.L., January 1969.

Since tapioca processing factories are non existent in the state, roots produced for animal feeding are normally cut in pieces, cooked and fed to pigs.

Expansion potentialities: Under utilization of kampong land has been a noticeable phenomenon in N.S. This is caused by other higher paying production opportunities than certain farming activities like paddy double cropping and kampong crop cultivation. The State Government is therefore, implementing a scheme providing incentives, to cultivate kampong land, in the form of supplying planting material and fertilizer. Edible tapioca is one of the crops included in this scheme.

In addition to forest reserve and Malay reserve, there are 144,000 acres of unalienated state land in N.S. This acreage represents the five fertility classed in the following distribution

Fertility Class	Acreage
1	7,000
2	13,000
3	92,000
4	13,000
5	19,000
Total	144,000

Class 1, 2 and 3 soil amounting to 112,000 acres of unalienated state land could be available for planting annual crops including tapioca. The state government has recently shown great interest in diversifying agriculture on a commercial basis in order not to be heavily dependent on rubber. In fact 10,000 acres of virgin jungle (class 2 and 3) have been approved in 1969 for alienation to The Green Acre Co. of Malacca for cultivation with tapioca and other food crops. The pattern of tapioca processing based on this acreage and the market outlet

are not yet clear, though tapioca in the form of processed chips would likely supply the large feed mills in Malacca.

8. Malacca

Tapioca cultivation in Malacca is confined to the sweet variety for human consumption. Acreage cultivated in 1968 was 850 acres of mixed crop only. No processing factories of any kind are found in the state.

Expansion potentialities: In addition to the forest reserve areas there are 6,700 acres of state land of which 3,000 acres of flat, drained, class-3-fertility land which may be considered for tapioca cultivation as well as other suitable crops. This area which is situated in the north eastern part of the state needs lime application for improved production. Experiments of lime applications have been carried out in this area on tapioca as well as pineapple. These two crops are being considered by the state government for cultivation in this area though tapioca is more favoured than pineapple on account of difficulties that would encounter the transport of the latter to distant canneries. Moreover, tapioca is being considered as a potential import saving; thus it could be used as a substitute for the 200 tons of maize imported monthly from Thailand alone by Malacca feed mills. At least one private company is interested in this area for tapioca cultivation. Farmers also, especially those living close to the area, have expressed their desire to plant tapioca.

As in Negri Sembilan the state government is adopting a diversification oriented landuse policy in an effort to break away from the 80% dependence on rubber.

Trengganu

According to the "Acreages of Miscellaneous Crops in 1968" Trengganu had only 1,587 acres sole crop equivalent of tapioca in 1968. No tapioca factories of any type exist in the state as the sole variety planted is the sweet freshly consumed type.

Though no tapioca project similar to that of Pahang is planned for Trengganu, this state as well as Kelantan are included in the study for two related purposes:

(1) To investigate potential expansion of tapioca cultivation for industrial purpose.
(2) To study the potential role of the two states in possible future development of a livestock/feed industry for the East Coast states.

As the state government of Trengganu is presently preoccupied with cultivation and expansion of maize, being a newly introduced crop with favourable potential in the state, no consideration is being given to tapioca (though few fertilizer experimental trials were observed). It is the general feeling of the state officials that since Pahang has started on tapioca they should stick to maize . This is favoured by general climatic conditions in Trengganu which suit maize, being short-term crop, thus escapes the monsoon season, more than the long-term tapioca industrial variety.

Last season 1,290 acres of maize were planted which by harvest averaged 9 piculs per acre which is a low average compared to what would be expected if farmers grew the "Metro" variety (20 piculs per acre). The whole of last season's crop was sold to Zulich feed mill at $12 per picul inclusive of transport cost which is $3 per picul. Thus net price paid to farmers was $9 per picul and their gross income was $81 per acre.

Planting target this season is 4,000 acres of which 2,700 acres are completed. Maximum potential expansion of maize is 40,000 acres of which 15% located in Kuala Trengganu district and 85% in Ulu Trengganu district. This maximum acreage is hoped to be achieved in about 14 years.

Feed ingredients availability: Without participation in an East Coast tapioca expansion program, Trengganu could eventually be an important supplier of the following feed ingredients:

(1) Maize
(2) Fish meal
(3) Copra cake
(4) Rice bran (especially from Besut district)

Possible tapioca expansion: Many difficulties would be encountered if serious efforts were to be made to expand tapioca cultivation substantially in Trengganu. Violent seasonal precipitation (monsoon floods on the one hand and drought on the other) and transport difficulties are the two major problems. However, if these problems were solved somehow, there would be about 30,000 acres suitable for tapioca cultivation of which 25,000 acres are located in Ulu Trengganu district and 5,000 acres in Kemaman district. The land reserved for maize expansion is, presumably, better in fertility and location.

10. Kelantan

The whole of the 3,143 acres sole crop equivalent of tapioca in 1967 were planted with sweet freshly consumed variety. This average was increased in 1968 to 3,691 acres planted but only 3,080 acres harvested. Mixed crop acreage is approximately 6 times as much as the sole crop acreage and is mostly located in Bachok district. Many farmers rely on tapioca grown in scattered elevated land as an additional source of food during the monsoon floods.

The state government of Kelantan seems to be quite willing to expand tapioca cultivation in new lands if it proves economical. However, as in Trengganu, this would likely encounter climatic problems and, in some areas, transport difficulties.

Possible tapioca expansion: A potential tapioca cultivation area is located in Pasir Mas district about 25 miles from Kota Bahru and amounting to 30,000 to 35,000 acres. This area, which was formerly used for grazing, is called "deficiency area" because of the symptoms of nitrogen and calcium deficiency observed on the grazing stock. Another possible area is 10,000 acres in Ulu Kelantan district. This is part of the land settlement scheme which cover the districts of Ulu Kelantan, Tanah Merah, Machang and Pasir Puteh. Communication problems would then be a major obstacle.

However, the situation would radically change in favour of tapioca cultivation and, in general, agricultural and marketing developments if and when the East West Highway is constructed. Kelantan would then, not only participate in the potential development of an East Coast Livestock/Feed industry through the provision of tapioca and rice bran as feed ingredients, but also have a strategic geographical location with respect to the flow of exportable livestock products and/or feed from the East Coast states to Penang.

Pahang - The Pilot Scheme

The importance of the state of Pahang in the present study is derived from its current role in implementing the first tapioca industry pilot project introduced in this country, based on modern processing technology and integrated production, handling, processing and marketing activities. The project is initiated by the state government and assisted by MARA. The state agri-

in the 1967 Survey of Manufacturing Industries in West Malaysia.*

Cultivation: Supervision of tapioca cultivation and related activities is at present a major concern of the Pahang State Agricultural Office. For the first time in this country deliberate efforts to systematically develop tapioca cultivation is observed in Pahang. These efforts take the form of agronomical experimentation (fertilizer trials in different soils), extension services, fertilizer incentive schemes and general organizational activities. Farmers' response has been, generally, very favourable and substantial acreage, in the areas visited, have been planted with tapioca for the first time.

The situation regarding the cultivation stage of the tapioca project as it stands now may be presented in the following table:

District	Small holders		Block Planting	Youth Schemes	Mara
	Target	Planted	Already Cleared	Planted	Reserved
	acres	acres	acres	acres	acres
Kuantan	3,500	1,300	-	200	2,500
Pekan	-	-	1,000	220	-
Raub	-	-	-	-	-
Lipis	-	-	1,000	150	-
Bentong	-	-	-	150	-
Temerloh	-	-	800	150	-
Jerantut	-	-	1,000	150	-
C/H' lands	-	-	-	-	-
Total	3,500	1,300	3,800	1,020	2,500

Notes:

(1) The starch factory which is being built by MARA 6 miles west of Kuantan will be supplied from areas located within a radius of 30 miles from the factory (in Kuantan and

* A chip factory exists in Raub district and has caused a recent considerable expansion in tapioca cultivation in that district.

Pekan districts) except the 1,000 acre block plantation in Pekan which is 50 miles away but the connecting roads are good.

(2) Districts other than Kuantan and Pekan are expected to channel their tapioca harvest to a chipping factory which MARA plans to build in Temerloh. This factory which is estimated to cost $350,000 will produce tapioca pellets* (compressed chips) for animal feed and, hopefully be ready for operation by May 1970.**

Estimated Supply: According to local officers, different soil types reflecting more or less different fertilities are represented in the acreages intended for tapioca cultivation in the various districts. The following soil types (some are locally named) and their corresponding fertility classes exist in the state:

Fertility Class	Soil type
I	Kuantan series
	Munchong
	Rengain
II	Briah
III	Holyrood
	Peat
IV	Peat
	Bris

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* This product is gradually replacing regular chips and tapioca meal in the EEC markets as animal feed ingredient.

** Recently a change in plans regarding the body responsible for the establishment of the Temerloh chip factory took place. Construction of this factory, which became the responsibility of the Pahang State Department Corporation (state owned), has not started yet. Tapioca roots harvested from acreage earmarked for this factory are at present being sent to Raub chip factory for processing.

The estimated yields of tapioca roots of these classes under proper farming practices and input application are reported to be as follows:

Fertility Class	Yield per acre (tons)
I	14
II	12
III	10
IV	8

These fertility classes are found in the areas which have been and intended to be planted with tapioca (exluding MARA reserved land) in the following general percentage pattern:

District	Planting Status	Soil Class	%	Acreage
Kuantan	Smallholders	I	10	350
		II	20	700
		III	35	1,225
		IV	35	1,225
	Youth Scheme	I	100	200
Pekan	Block Planting	I	100	1,000
	Youth Scheme	II	50	110
		III	50	110
Lipis	Block Planting	II	100	1,000
	Youth Scheme	II	100	150
Bentong	Youth Scheme	II	50	75
		III	50	75
Temerloh	Block Planting	II	50	400
		III	50	400
	Youth Scheme	III	100	150
Jerantut	Block Planting	II	50	500
		III	50	500
	Youth Scheme	II	50	75
		III	50	75

Based on this table and using the estimated yield figures reported for the various soil fertility classes, annual production of tapioca roots for each district and the estimated annual supply for the starch and chip pellet factories would, thus, be as follows:

District	Estimated Production Tons per Year	
Kuantan	38,150	
Pekan	16,420	
Total Supply for Starch factory		54,570
Lipis	13,800	
Bentong	1,650	
Temerloh	10,300	
Jerantut	12,650	
Total Supply for Chip factory		38,400
Total Annual Supply for the Project area		92,970

The starch factory which was originally scheduled to have started operation in October or November 1969* will have initial capacity of 100 tons of root intake to be increased to 120 tons. Assuming a 300-day operation per year estimated supply from Kuantan and Pekan districts would provide 180 tons daily average. However, if tapioca cultivation follows a crop rotation that allows only 50% of the designated acreage in tapioca at any one time, more acreage would naturally be needed to maintain the level of root supply required to keep the factory fully operated. The additional acreage reserved for MARA would then take care of this shortage and

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* Recent indications show that due to various delaying difficulties the starch factory is not experted to be ready for operation before June, 1970.

of that caused by possible smallgrowers drop-outs.

Insufficient information is obtained on the chip pellet factory proposed to be established by the Pahang State Development Corporation in Temerloh. However, the question which needs an early answer is neither root production nor chip processing but rather the disposal of chips. With estimated 38,000 tons of annual production of raw material and a 40% recovery, a market for about 15,000 tons of chip pellets has to be found. Contacts with the EEC countries, which, as shown earlier, have been increasing their imports of tapioca pellets, should soon be made.

Cultivation Cost: Certain cost figures for jungle clearance and tapioca cultivation were quoted from a local officer with ample experience. These figures on a per acre basis are as follows:

Jungle clearance:		$150 to $160
(expensive in Pahang as labour is imported)		
Planting (labour cost): including making own paths		
Kuantan		$40
Raub		$25 to $30
Average		$30
Weeding (labour):	1st round	$20
	2nd round	$15
	3rd round	$15
Fertilizer (material):		$50 for 3rd crop
(labour included in weeding)		
Pest and disease control:		negligible
Harvesting (labour):		$45 to $80 depending on soil nature; easiest: sandy after rain.

On the average, one man harvests 1 ton per day.

Note: All labour cost figures apply to the first crop. Subsequent crops are expected to be less costly.

General Problems

At this juncture of the tapioca industry pilot project in Pahang certain problems seem to have appeared in the horizon and it would be extremely desirable that they should be tackled at an early stage. These problems may be summarized as follows:

1) First and foremost the timely completion of the starch factory is of utmost importance. Substantial acreage of tapioca is now (December 1969) ready for harvest. The only possible outlet for farmers' crop is processing and it would be a serious setback for the project at the very outset if the factory is not operational at the earliest time possible. Firm action should be taken to remove any obstacle that may cause undue delay in completion in time.

2) Prices paid to farmers and buying method have not been worked out. It would be difficult for extension agents to provide farmers with concrete incentives without the knowledge of prices farmers should expect and on what basis.*

3) In as much as most of tapioca smallholders are preoccupied by other activities like fishing, paddy planting, etc. it becomes increasingly difficult to organize them to work according to a timetable, an essential procedure for the success of the project. This problem is accentuated by fluctuations frequently occuring in businesses related to the farmer's varied enterprises which would

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* It has been recently learnt that, subject to possible alteration, a price of $1.70 per picul would be paid for roots containing 22% starch. This price would vary with varying starch content.

likely dull his interest in tapioca at times.

4) The project is originally motivated by the desire to assist a subsistance farmer and utilize submarginal land. As such, problems of meagreness of resources and low soil fertility might deter smallholder production, unless production credits, extension services and price incentives are provided by the organizing machinery.

5) Maintenance of a steady flow of daily supply reaching the factory at a proper time requires complete synchronization of planting, harvesting and transport operations. This would be relatively easy for an estate. For a diverse group of farmers, however, the problem becomes of a substantial magnitude and requires top level managerial ability.

B. Marketing.

Exports

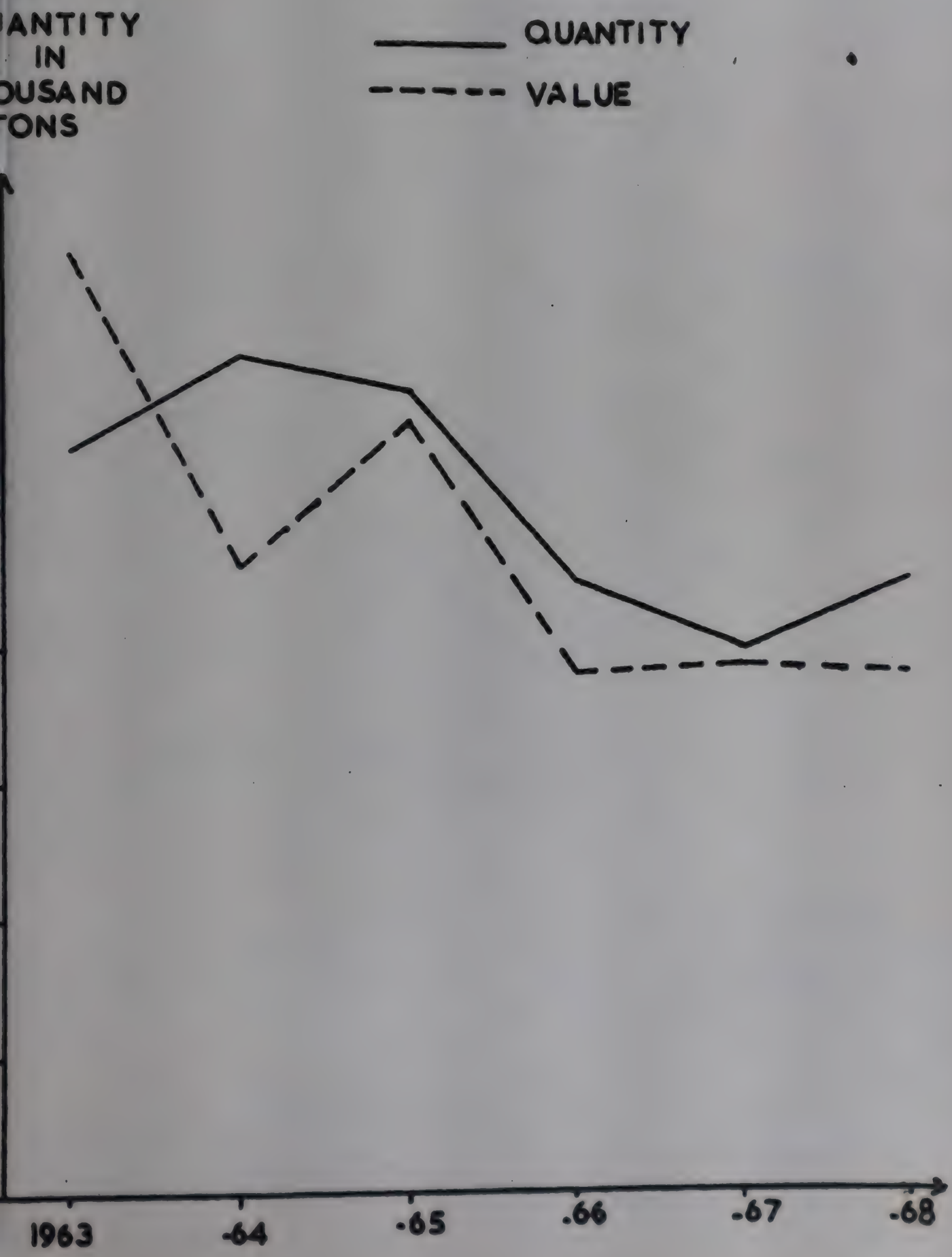
Malaysia's annual export value of tapioca products amounts to about M$5 million. In terms of both quantity and value, tapioca products exported are largely in the form of pearls, flour and flakes, in this order. The average quantities and f.o.b. export values over the three years 1966 to 1968 for these products were: -

	Quantity	%	Value	%
	1 Tons		M$1,000	
Tapioca Pearl	11,569	65.9	3,105	68.2
Tapioca Flour	5,199	29.6	1,248	27.4
Tapioca Flakes	768	4.4	197	4.3

The major importers of Malaysian tapioca pearl in 1968 were Pakistan, U.K., Ceylon, Belgium and Luxemburg, Australia and Burma in this order. The bulk of tapioca flour has gone to Singapore. Importers of tapioca flakes were Singapore, U.K., Italy and Portugal.

Quantity exported of tapioca products as a whole has trended downwardly especially between 1964 and 1967. However, pearl exports have increased considerably since 1966 due to expanding imports of mainly Pakistan and partly Ceylon. Flour exports have reached a very low point in 1967 due mainly to the big jump in the tapioca flour imports from Thailand into Singapore - the major importer of Malaysia flour and also due to the discontinuation of U.S. imports of Malaysian flour.

TOTAL EXPORT OF TAPIOCA PRODUCTS FROM W. MALAYSIA 1963-68



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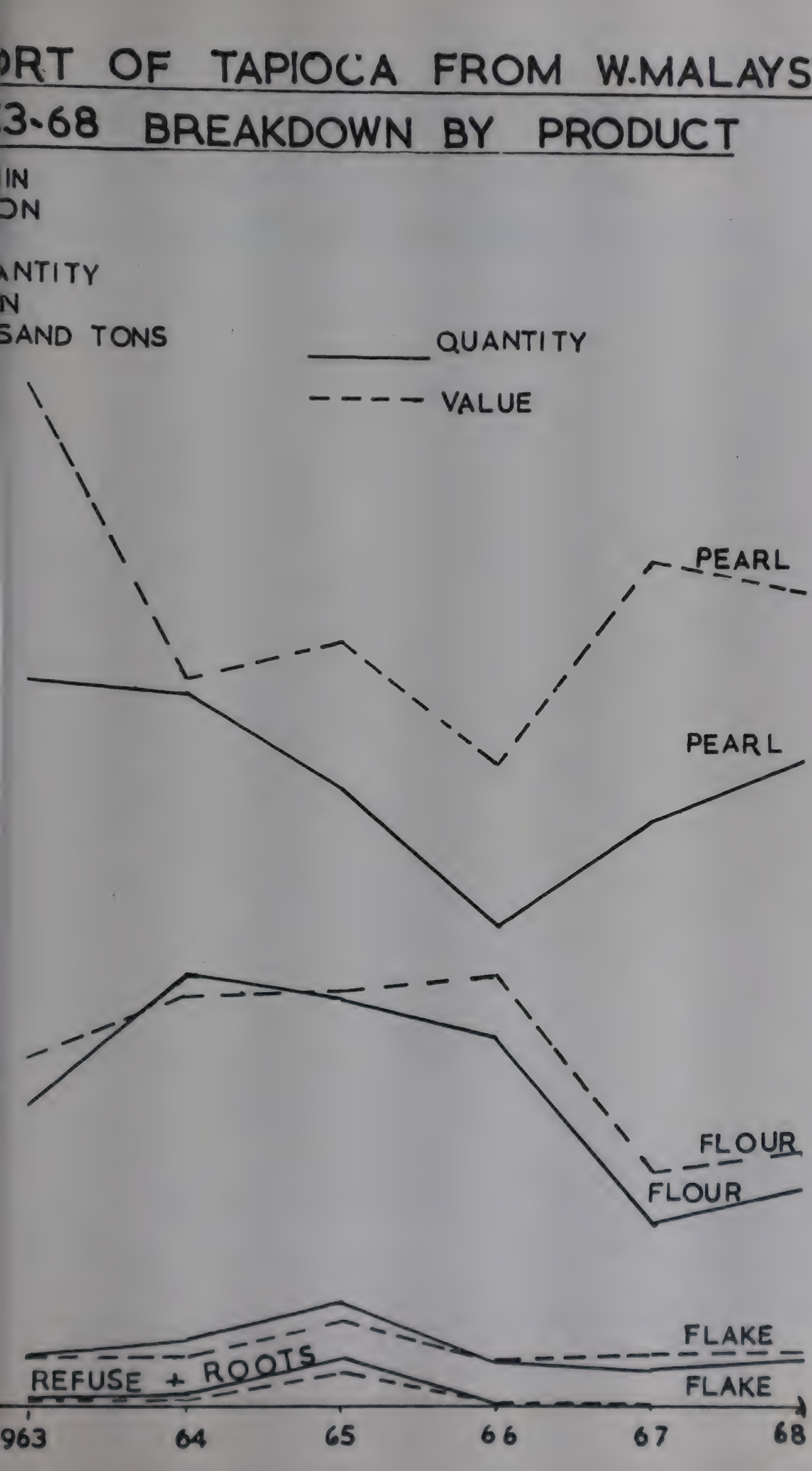
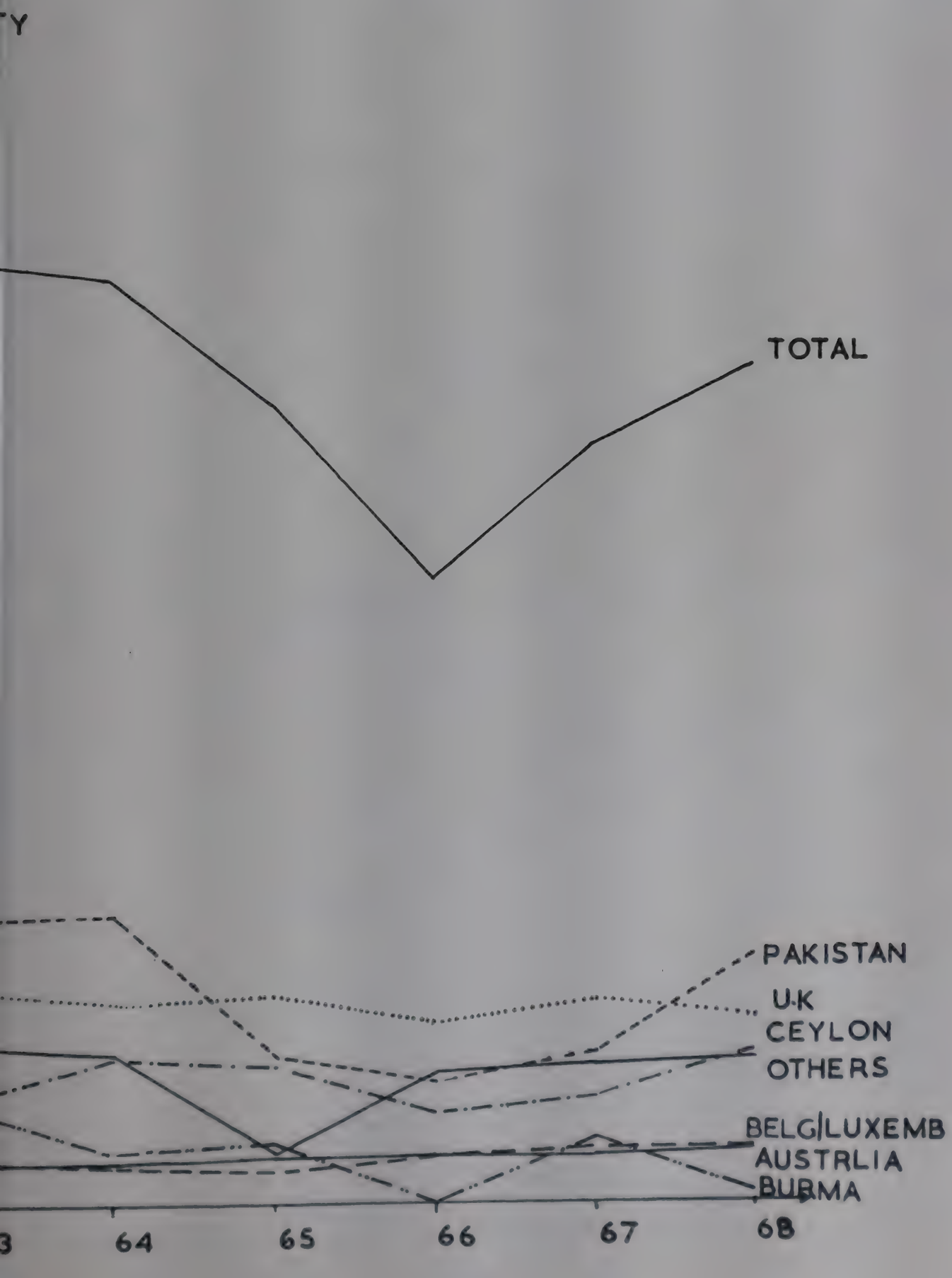


EXPORT OF TAPIOCA PEARL FROM W. MALAYSIA 1963-68 BREAKDOWN BY IMPORTING COUNTRY



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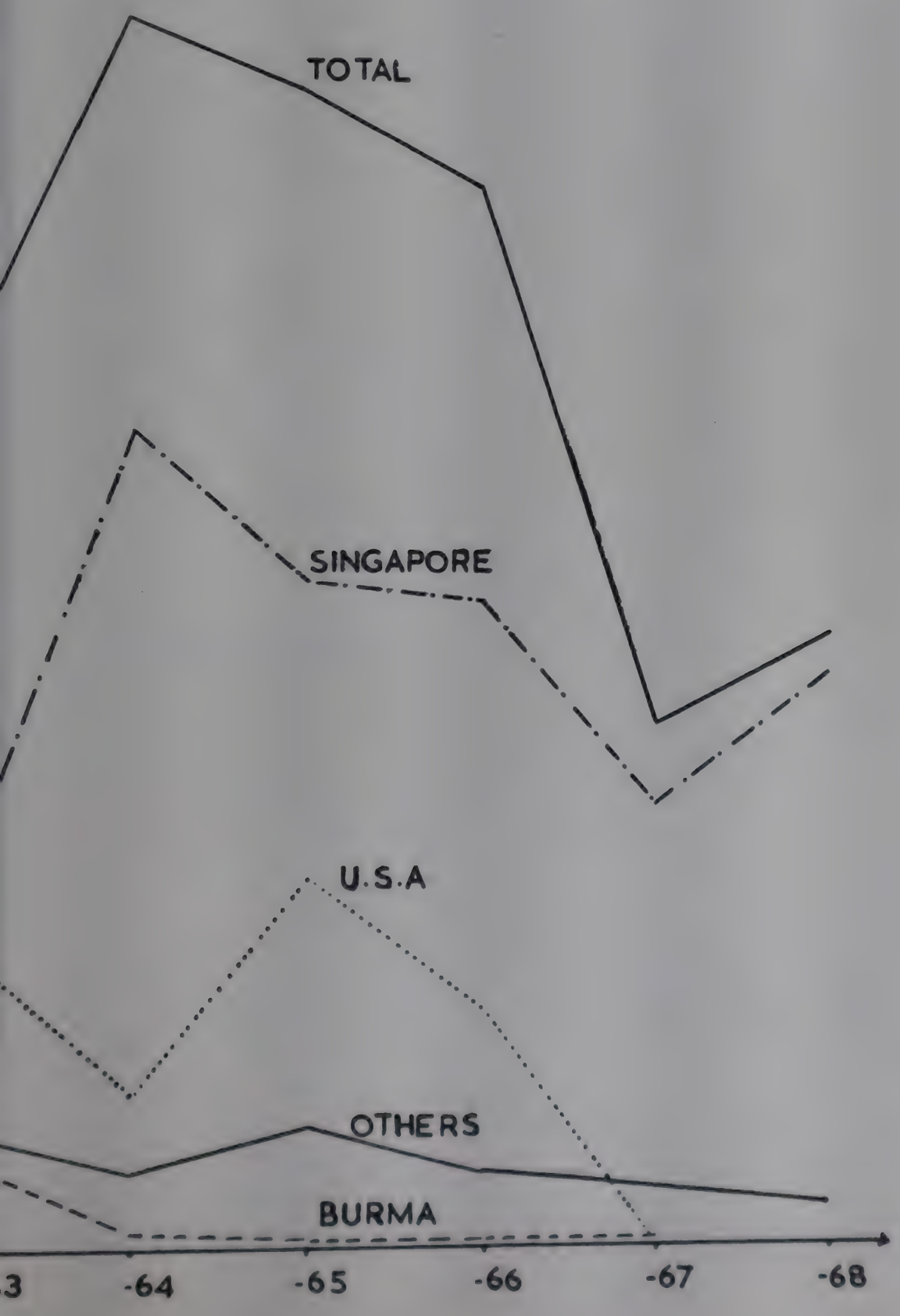

EXPORT OF TAPIOCA FLAKE FROM W.MALAYSIA 1963-68 EAKDOWN BY IMPORTING COUNTRY

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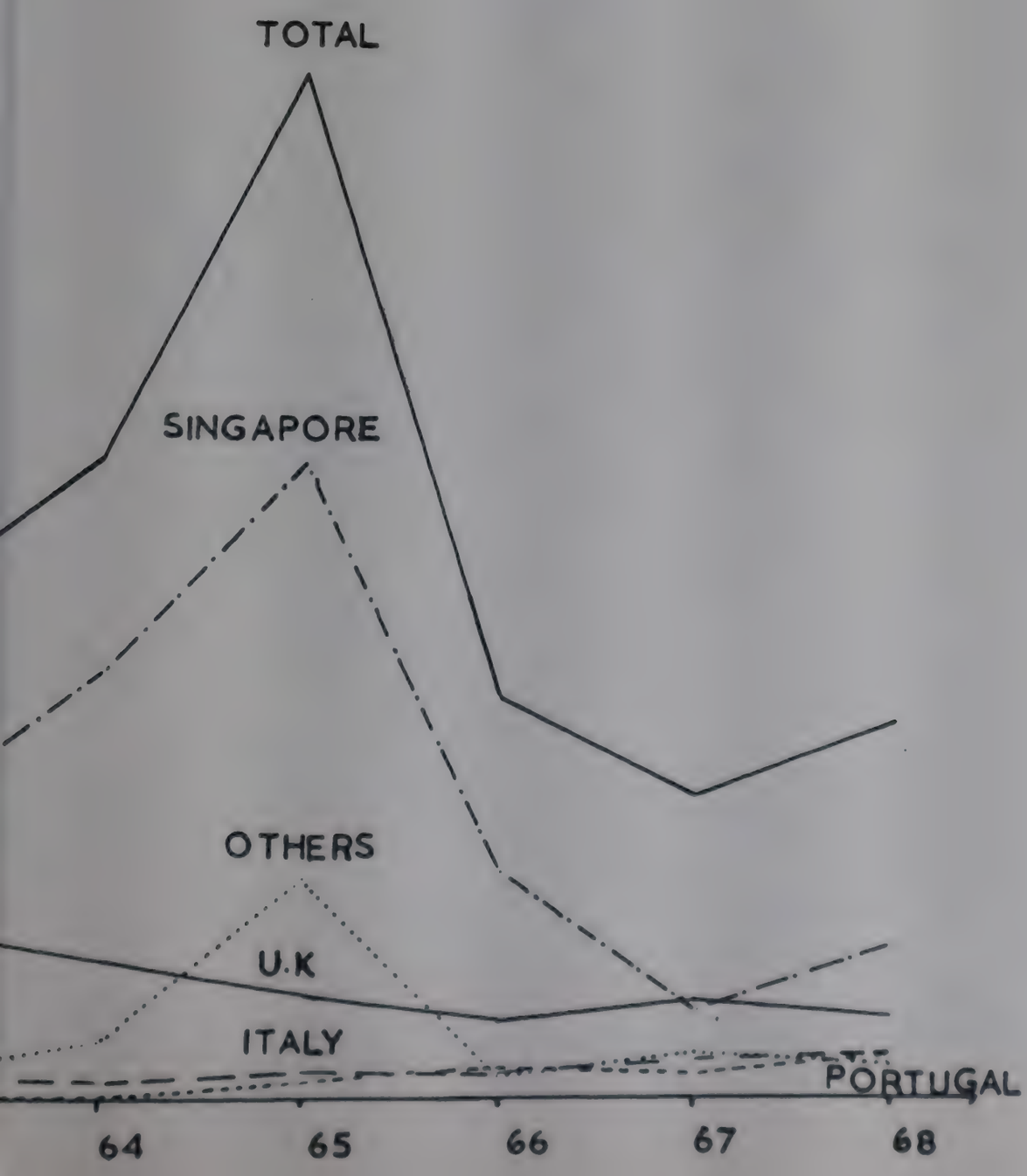

W. MALAYSIAN F.O.B PRICES 1962-1968

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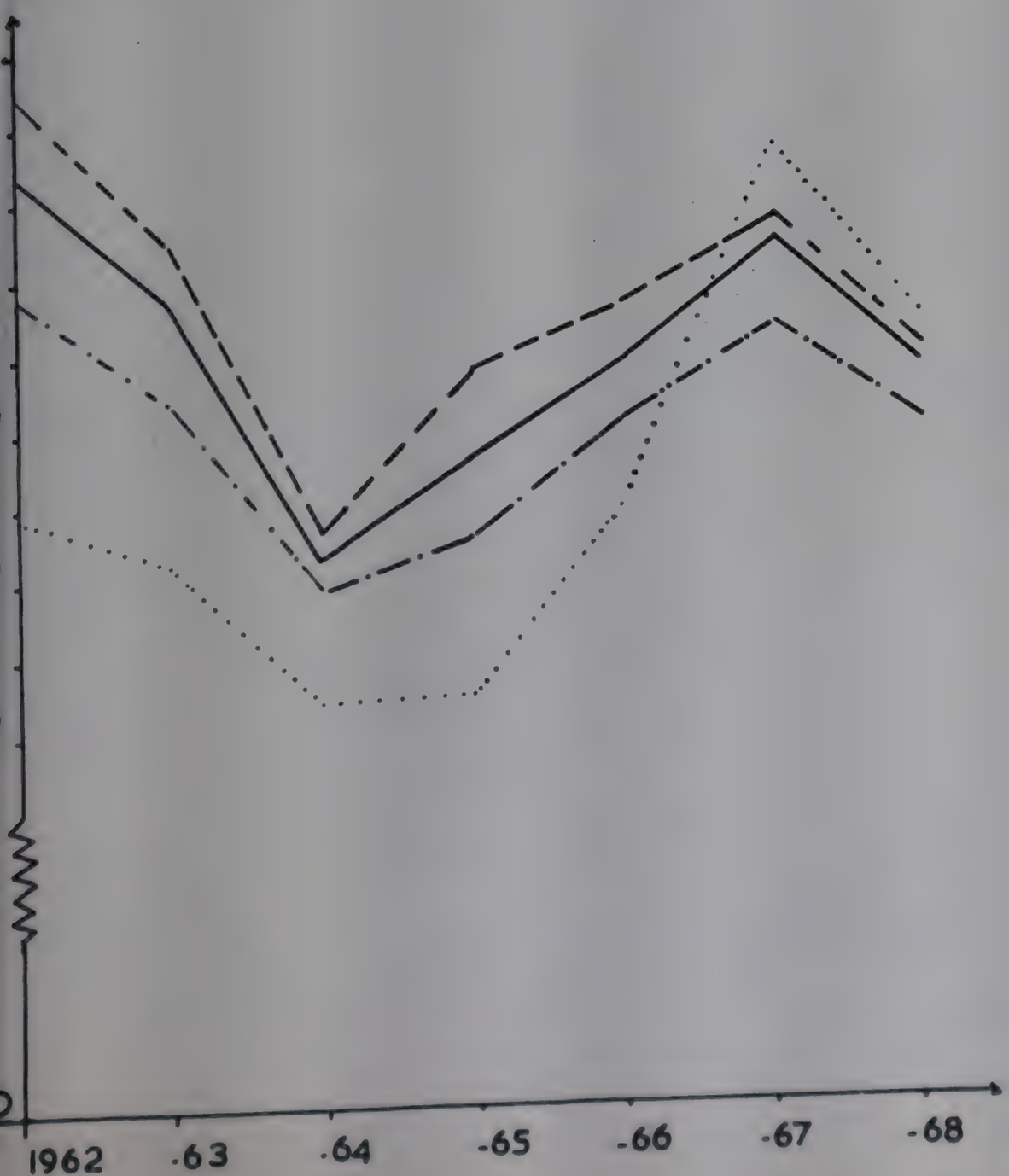
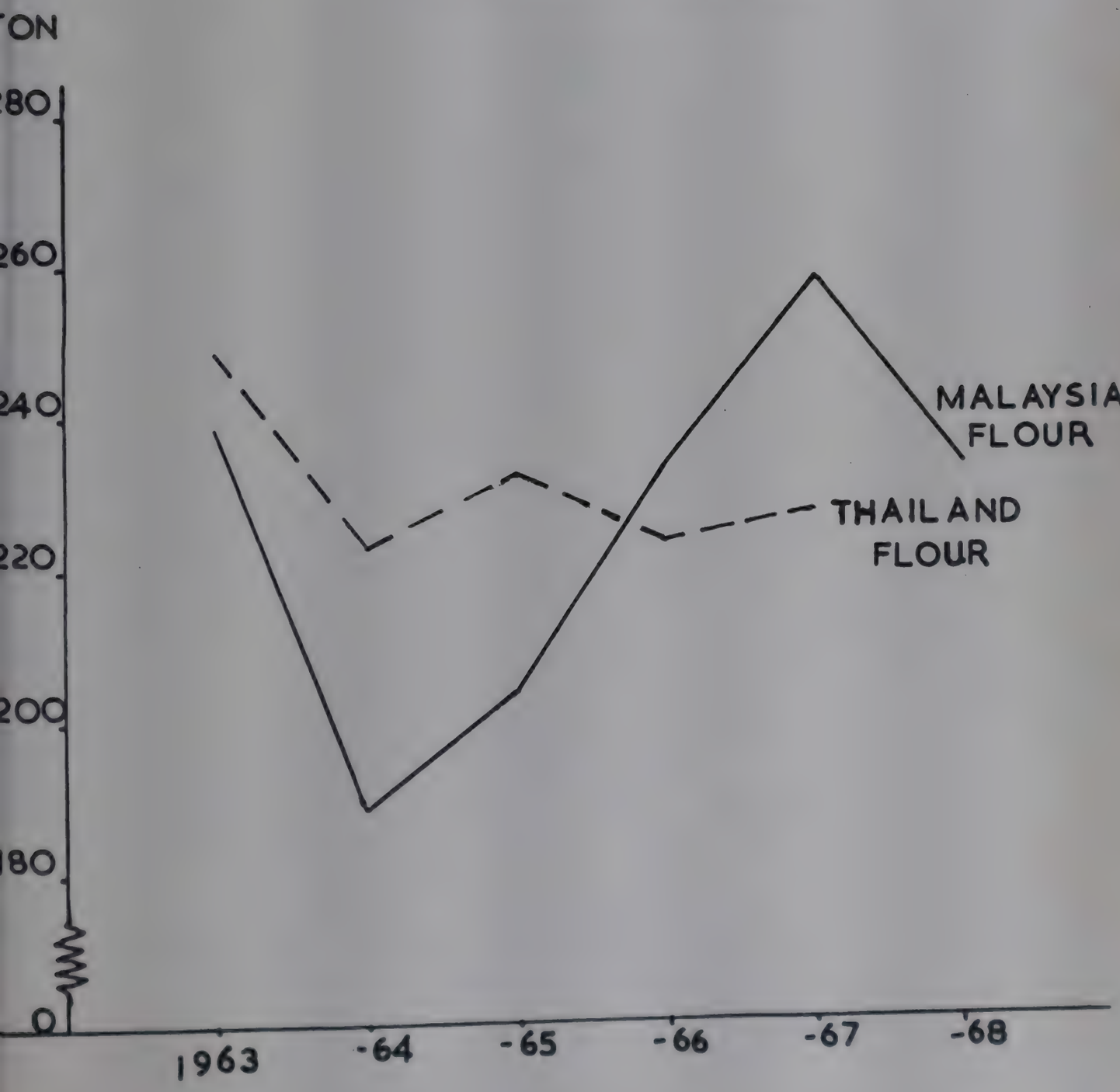
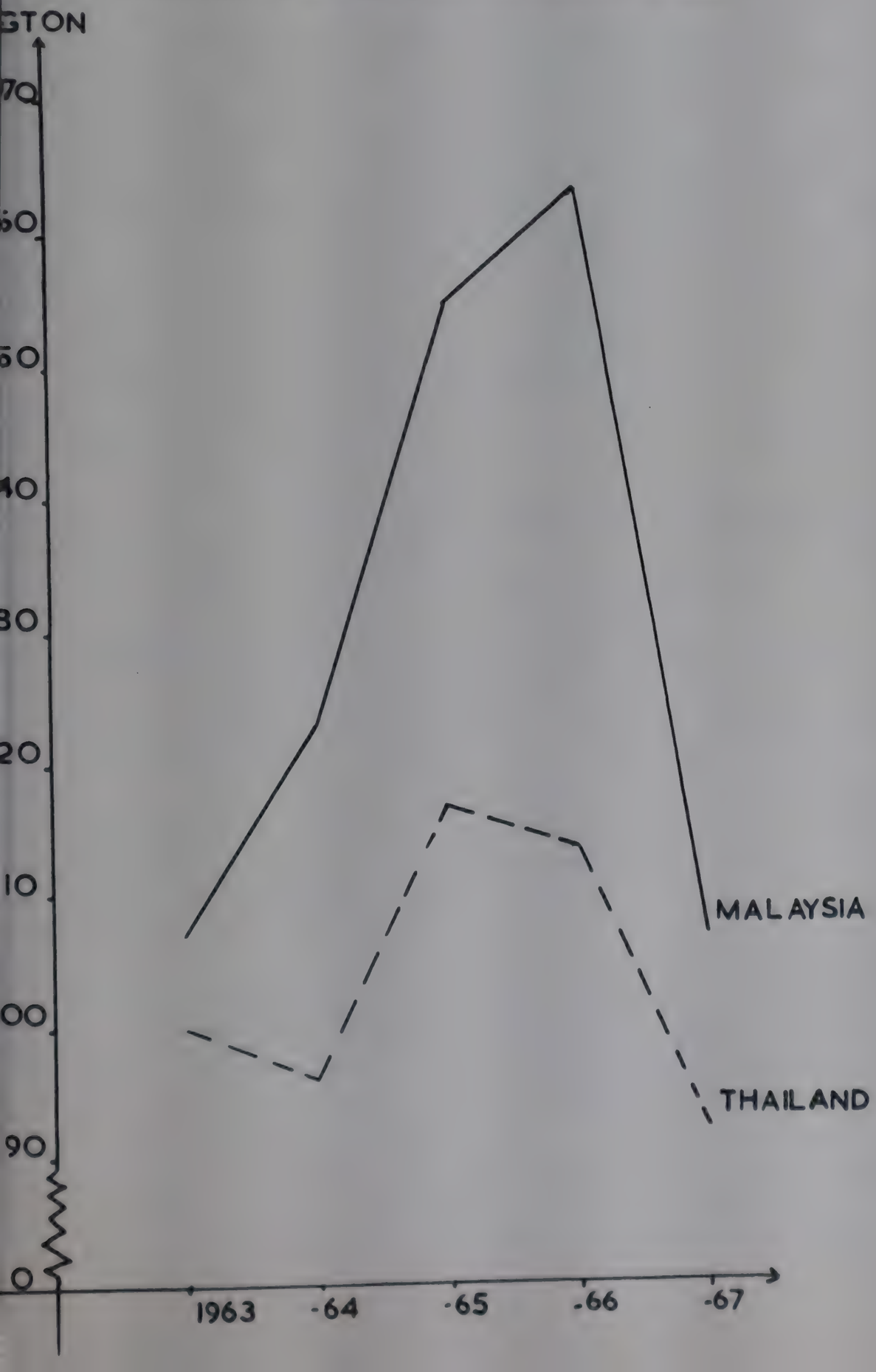


F.O.B PRICES OF EXPORTED FLOUR FROM MALAYSIA AND THAILAND



F.O.B PRICES OF EXPORTED REFUSE (WASTE) FROM MALAYSIA AND THAILAND



Survey of export agents

In order to obtain first hand information on the export situation of the Malaysian tapioca products, a questionnaire form was prepared to survey the main export agencies in Penang. Five shippers and exporters who are known to handle the bulk of the tapioca exports were interviewed during the month of October 1969. Following are the results of the exporters questionnaire.

Total quantity of tapioca products (flour, pearl and flakes):

Handled (tons) in 1968	of which exported (tons)
15,640	15,280

Source of Supply: Perak, P.W. and Kedah

Adequacy of supply for foreign market: Yes: 4 No: 1

Transport from factory to port:

Mode: Lorry

Suitability: Satisfactory. No adverse effect on quality

time: ½ hour to 4 hrs

charges: normally $0.50/picul.

Channel: Directly from factory to exporters; then mostly to commission agents and importers abroad.

Prices paid ex-factory in 1968 - Average weighted $/pic

	Flour	Pearl	Flakes
Normally	13.15	13.57	18
Maximum	14.25	14.53	18
Minimum	10.62	11.16	18

Storage of products by exporter: Only if delay in ship arrival occurs. Quality is not affected before 2 months storage, a time period which is never reached under normal conditions. After 2 months, however, moulding and discolouration would take place.

Export Destinations

Country of destination	Flour	Pearl	Flakes
	%	%	%
U.K.	15.9	7.4	
U.S.A.	33.9		
Pakistan		39.4	
Portugal	2.4		
Ceylon	2.4	5.1	
S'pore	9.7		
Australia	5.6	2.2	
S. Africa		0.9	
Germany		0.4	
Belgium		1.3	
New Zealand		2.2	
Other Countries	17.9		
Unknown Destination	12.2	41.1	100

Packaging: Paper sacks mostly for starch weighing 100 - 112 lbs. Gunny sacks mostly for pearl and flake weighing 56 to 224 lbs.
The type and size of container depend upon the country of destination and buyers requirements.

F.O.B. prices in 1968: Approximately one dollar higher than ex-factory price plus handling and transport charges to the port.

Shipping charges in 1968

From Penang to:	US $/L.Ton			
	Flour	Pearl	Flakes	Unspecified
U.K. and Continent	31.50	39.65	-	35.10
				55.25*
U.S.A.	-	-	-	30.50
Canada (Vancouver)	26.25	-	-	-
S.Africa	-	18.50	16.75	-
Ceylon	-	-	-	18.15
Pakistan (Karachi)	-	-	-	20.60

* Includes commission paid to agent

Effect on quality during shipping:

Damage: If stored next to rubber - rubber smell

" " " " boiler - discolouration

" sea water

Weight shrinkage

Complaints received about quality:

Exporters of more than half total exports in 1968 received complaints about the quality of 1-2% of their exports.

Causes of complaints: (1) colour (2) High moisture contents (3) Insect infestation (weevils)

Quality compared with that of Thailand's: Thai starch is better - more uniform.

Delay in ship arrival:	Normally	Maximum
	1 - 2 days	10 - 15 days
in ship departure	1 - 2 day normally	

Port service facilities: Mostly unsatisfactory on account of slow custom paper work and inspection of goods. Port charges: $1.20/ton.

Promotion in Foreign Markets: Very limited based on individual efforts.

Market news: All exporters have access to market information regarding type, price, quantity, etc. This information is reported to be relayed to factories immediately by phone.

Problems (1) shortage of land for tapioca cultivation and high land tax for growing tapioca ($20/ acre in Perak resulting in shortage of root supply.

(2) Obsolete processing machinery caused by

a. Lack of capital for innovation.

b. Lack of incentive to modernize as the root supply is not secured.

(3) High shipping charges (about US$6 per ton more than from Thailand.

2. Imports

Though Malaysia is an overall tapioca product exporter, a large quantity of tapioca refuse is imported annually from Thailand. Total quantity of imports has more than doubled since 1962. This has been causing great concern among starch factory operators since the Thai refuse, which is evidently superior and uniform in quality compared to that produced locally, sells in the local market at competitive prices. Quantities, values and prices of tapioca refuse imported into W.Malaysia during the years 1962 to 1967 were as follows:

	Quantity	Value	Price
	Tons	$1,000	$/ton
1962	8,239	1,227	149
1963	13,579	1,587	117
1964	10,708	1,181	110
1965	14,785	2,066	140
1966	14,785	2,022	137
1967	19,343	2,160	112

3. Domestic

The domestic market for tapioca starch is represented mainly by the food industries. The largest consumers of starch in this country are the manufacturers of monosodium glutamate and glucose.

The principal domestic users of tapioca flour in this country are:

Monosodium Glutamate Factory: Uses exclusively tapioca flour as a raw material. Average monthly consumption of flour was 300 tons in 1968 (3,600 tons for the whole year). This average has increased in 1969 to 350 tons/month. Flour intake target for 1970 will be 550 tons per month and for 1972 is expected to reach 850 tons per month, i.e., more than 10,000 tons annually. At present tapioca flour is supplied by three starch factories in Perak around Ipoh. Previously, there were six suppliers, but because some were unable to deliver the required (contracted) quantity and/or quality of

flour, three factories had dropped out. The price of flour paid at the factory in K.L. ranged between $11 to $13.50 per picul exclusive of the sacks. The variation in flour price was due to fluctuation in root supply and flour production. Quality requirements are set at 85% minimum starch and 15% maximum moisture contents, in addition, flour should undergo two washings during its processing.

Glucose Factory:

Uses exclusively tapioca flour as a raw material. Established two years ago (1967) and was granted pioneer status. Average monthly intake of flour is about 120 tons (about 1,440 a year). This quantity is not expected to increase significantly in the forseeable future. This intake of tapioca flour is at present supplied by 6 starch factories around Ipoh some of which have contracts with the Glucose factory. The price of flour at present paid at starch factories in Perak is about $10.00 per picul and has ranged during the last 2 years between $10 to $17 per picul. Certain quality specifications are strictly required by the factory. Among those specifications which are closely guarded is a 12% maximum moisture content. Each shipment arriving is subject to a laboratory test. Glucose from tapioca flour recovery rate was reported to exceed 90%. Annual glucose production is therefore, approximately 1,300 tons. Only 5 to 10% of the factory's production of glucose is being exported. The rest, which is claimed by the factory management to adequately cover the needs of domestic market is channelled locally. Glucose price at present ranges between 20¢ to 25¢ per pound. In two year's time since the factory started operation, sales price dropped from $650 to $540 per ton of glucose.

Glucose Factory: Produces glucose from tapioca flour exclusively. It was granted a pioneer status for 3 years (1969-1972). Monthly production of glucose in 1968 was 100 tons (produced from 150 tons

of tapioca flour at the reported recovery rate), though maximum attainable capacity is at least twice that much. The factory can also use sago starch but in addition to being more expensive its recovery is less than that of tapioca starch. Tapioca flour is supplied by starch factories around Ipoh and Chemor. Price of flour delivered at factory in K.L. ranges between $14 and $16 per picul subject to laboratory test of moisture content which should not exceed 11%. The glucose produced is sold mostly to confectionery factories and to a lesser extent to biscuit factories. Only small quantity was exported, mostly to HongKong. Certain quantity of glucose amounting to 40 to 50 tons is reported to be smuggled monthly from Thailand into Malaysia and selling for as low as 10¢ per pound.

Glucose production, exports and imports: The foregoing two glucose factories together produce about 2,500 tons of glucose annually. Since their production came into effect the annual imports of glucose into W. Malaysia has dropped from an average of 1,450 tons annually in 1964/65 to an average of only 33 tons annually in 1966/67. On the other hand exports have increased from an average of only 3 tons annually in 1964 - 66 to 57 tons in 1967 (External Trade Statistics W. Malaysia).

It is, therefore, obvious that, given the present domestic market demand for glucose, the production of these two factories more than adequately satisfies the domestic present needs. Any expansion in glucose production beyond the present level would only be justified by creating new industrial uses by way of substitution for the cane sugar (or in general sucrose) or channelling the surplus through the foreign market which seems to be highly competitive.

Alcohol Factory: Produces alcohol (denatured) for industrial use. Originally, when the factory was established in 1965, tapioca roots were used as a raw material. However, due to a sudden rise in root market price caused by the entrance of this factory as a

substantial buyer, they were not able to obtain the required supply at the contracted price which was evidently lower than the market price. Consequently the factory found it more economical to turn to molasse as raw material, which since has been procured on contract from a sugar factory in Prai (P.W.) at $85 a ton. Recently, however, molasse price has risen due to higher demand caused by the entrance of new buyers into the market like a yeast factory and feed mills. The alcohol factory is, therefore, planning to switch back to tapioca roots in 1970. Other reasons are the utilization of all machineries which were originally planned for tapioca roots and the utilization of tapioca waste in a factory owned feed mill in an adjourning lot. At the present utilization capacity of the factory (which is 36% of the maximum attainable capacity), and at the reported recovery rate (which is 30 gallons of alcohol per ton of tapioca roots), total annual intake of tapioca roots would be expected to approximate 7,000 tons. The tapioca root and molasse prices at which the alcohol manufacturer would be indifferent to use one or the other as a raw material was reported to be $2/picul for the former and $85/ton for the latter.

Other user of tapioca starch is the yeast industry, though molasse is usually preferred as a raw material for its additional nutritional value in the form of minerals. Molasse competes on a price basis with tapioca flour in the manufacturing of monosodium glutamate. The switch from one raw material to the other, however, requires modifications in the processing machinery. A factory located in Kuala Lumpur which uses exclusively molasse for the production of monosodium glutamate stated that molasse becomes competitive with tapioca flour at not more than $80 per ton. Since this factory is at present paying $100/ton delivered from Prai sugar factory to K.L., it is planning to switch to tapioca flour if this high molasse price persists.

Other domestic outlets for starch products are provision shops selling directly to the consumers, and small food industries like bee hoon, noodles, ice-cream, biscuits, confectionery, fish and prawn chips, etc. Certain amounts of starch are being used by paper and textile industries; laundry industry is also using tapioca starch though on a declining trend due to gradual long term switch in taste.

The domestic market for tapioca chips is represented by animal feed mills which use them as ingredients in the compound feed ration and by livestock farmers who feed them along with other ingredients, mainly, to their pigs and poultry.

IV. THE SURVEY OF FACTORIES

The structure of the tapioca industry in Malaysia is such that much of the ground level information relevant to the functioning of the industry as a whole could be exclusively obtained from the processing sector. This is due to the following observations:

(1) Close direct relations are established between factories and farms

(2) Relative homogeneity in practices and problems prevail among root producers within kampong (legal) and jungle (illegal) farm sectors

(3) Certain problems of tapioca cultivation are logically concluded from the present state government policies toward this crop.

A. The Universe Investigated

The bulk of the tapioca processing establishments using mainly cassava roots as raw material is found in the states of Perak, Penang and Province Wellesley and Kedah in this order. All otarch and chip factories operating in these three states were therefore considered as the universe from which the largest possible number of factories have been investigated during the field survey which took place in August 1969. Since it was not feasible to visit 100% of the factories in the three-state region, this survey falls short of being a complete census and hence reliance is placed on averages rather than aggregates. On the other hand since the great majority of the factories have been interviewed, results expressed in average form should be highly reliable.

Time reference for certain information, sought by the questionnaires, which represented a full calender year was the

year 1968. Other types of information reflected current particulars, practices and behaviour.

Two questionnaire forms, one for starch factories and the other for chip factories, were prepared. These questionnaire forms were mainly designed to seek answers to questions of plant capacity, root supply, starch & chip production and marketing, capital investment and in general processing problems. Questions pertaining to processing cost were completely avoided since only an over-optimist would expect any reliable answers to these questions if at all, especially in view of the general conditions under which tapioca processors operate and which make their interviewing an extremely sensitive task.

The actual interview was done by locally recruited enumerators who were trained and very closely supervised by the authors of this report.

The complete list of starch and chip factories comprising the universe of this survey was compiled from three sources:
(1) A complete list obtained from the Department of Statistics which was used by the Department as a basis for conducting the Survey of Manufacturing Industries in West Malaysia, 1967.
(2) A complete list requested from and prepared by the respective states agricultural offices.
(3) A partial list of starch and chip factories not included in either of the above two lists but discovered during the survey field work.

Some of the factories included in the first two lists, amounting to nine in number, were found, during the field survey, to have discontinued operation for various reasons.

1. Starch Factories

The universe of starch factories as well as factories which were actually interviewed are distributed among the states of Perak, Province Wellesley and Kedah and their districts as follows:

State	District	Number of starch factories		% of Universe Interviewed
		Universe	Interviewed	
Perak				
	Kuala Kangsar	4	3	
	Kinta	10	10	
	Dinding	1	0	
	Batang Padang	3	3	
Perak Total		18	16	89%
P.W.				
	B'worth North	3	3	
	Bt.Mertajam (Central)	4	4	
		7	7	100%
Kedah				
	Baling	1	1	
	Kuala Muda	2	2	
	Kulim	1	1	
Kedah Total		4	4	100%
3-State Total		29	27	93%

2. Chip Factories

Perak was the only state, in the region covered by the survey, where chip factories are found. The universe of chip factories as well as those factories which were actually interviewed are distributed among Perak districts as follows:

Perak Districts	Number of Chip Factories		% of Universe Interviewed
	Universe	Interviewed	
Kinta	17	17	
Batang Padang	5	4*	
Lower Perak	9	6	
Perak Total	31	27	87%

* All four chip factories interviewed in Batang Padang district are owned by Malays. These and possibly few other chip factories known to exist in this district are the only tapioca processing establishments in the survey region owned by Malays. All the rest (starch and chips) are owned by Chinese.

Analysis of Questionnaire Results

(1) STARCH FACTORIES

General Particulars:

Ownership status: The majority of the 27 starch factories interviewed (55.6%) are owned by private individuals. The remaining ownership is equally distributed between private companies and partnerships. No factories are owned by cooperatives.

Age of factories: The age of factories since they were originally built ranges between two years up to as long as 90 years with an average of 24.7 years.

The following table shows the age structure of the starch factories interviewed:

Age Class (yrs)	< 5		5- < 10		10- < 15		15- < 20		20- < 30		30- < 40		> 40	
	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Frequency	1	3.7	3	11.1	3	11.1	6	22.2	4	14.8	7	26.0	3	11.1

It can be observed from this table that more than 50% of the starch factories are 20 years old or more. However, 60% of the factories interviewed have undergone certain renovations like adding new machines, extending the kiln areas or building extra sedimentation tanks. The average age of those renovated factories is now 28.4 years and the renovation took place 3.3 years ago on the average.

b. Capacity

In terms of fresh root intake, the average annual operating capacity of the starch factories interviewed is 155,525 piculs (9,257.4 tons) per factory totalling 4,043,662 piculs, annually (240,695 tons).

The following table shows the capacity structure of the starch factories interviewed:

Annual Capacity Class (1,000 pic)	< 25		25- < 50		50- < 100		100- < 200		200- < 300		> 300	
	No	%	No	%	No	%	No	%	No	%	No	%
% of total	0	0	2	7.7	4	15.4	12	46.1	6	23.1	2	7.7

Only six factories out of the 27 interviewed process sago palm in addition to tapioca roots. The quantity of sago palm intake comprises less than 1% of the total raw material used.

In view of the continuous supply of fresh roots the starch factories interviewed were found to be working 347 days per year on the average ranging between 300 and 365 days. Daily operating hours were, however, only 8.4 hours per day on the average ranging between 6.5 and 10.8 hours. This is due to insufficient, though continuous, supply and, presumably, the existence of processing bottlenecks under the present method of technology.

The maximum attainable daily capacity (potential) has been reported as 695 piculs (or 41.4 tons of roots) per factory on the basis of an average of 10.7 operating hours per day. This maximum potential is based on unlimited supply of roots subject to the existing "shortrun" processing bottleneck constraints. The survey has, thus, revealed that the actual operating capacity of the starch factories in Perak, Penang & Province Wellesley and Kedah is 61% of the capacity that would be attained if sufficient root supply were available.

c. Fresh Root Supply

Distance: The average distance travelled by tapioca roots from field, to starch factories vary between states as well as within states. The following table shows the distances normally travelled and also maximum distances for the factories located in the states of Perak, Province Wellesley and Kedah:

No. Reporting	Average Distance	
	Normally (miles)	Maximum (miles)
Total 27	27.9	61.7
Perak 16	22.2	59.7
P.W. 7	42.9	75.7
Kedah 4	24.8	45.0

Origin: It is not an unknown fact that a substantial portion of root supply (generally estimated as 70%) comes from illegal cultivation (in the jungle) in the State of Perak. Naturally none of the factory operators would freely admit that he is engaged in purchasing his supplies from illegal sources. Though the word "illegal" was replaced by "jungle" in the questionnaire forms, it was obvious that too few operators reported certain quantities supplied by jungle cultivation.

Except for supply originated from own farm land, answers to the supply origin question could not, therefore, be reliable unless we generalize from selected individuals. About 7% of the total root supply came from land owned by factory operators, the rest (93%) was supplied by "Kampong" and "jungle" farms. Because the majority of the respondents (59%) have referred to the jungle supply portion as coming from "Kampong" farms the breakdown of the combined figure (93%) of Kampong and jungle contributions has been reported as high as 70.5% for the farmer and as low as 22.5% for the latter.

By considering the questionnaire results of those relatively few unsuspicious individuals who reported the jungle as a source of supply it was found that 58% of their root intake came from that source and 42% came from Kampong farms and own land combined.

Flow pattern: Most of the factories interviewed (20 out of 27) encounter no seasonal fluctuation in root supply. The fluctuations reported by the remaining 7 factories are of minor magnitude resulting in slightly higher supply than the monthly average during the months of March through July and slightly lower during the months of August and September. The overall picture does not, however, deviate significantly from an even pattern.

Time lapse: An established technological fact is that to obtain tapioca roots of high processing quality they should be processed within the shortest time possible after harvest, as the delay in the delivery of the roots to the factory or in their processing would have detrimental effect on the quality of the final product.

The survey has revealed the following time lapse averages between harvesting and unloading and between unloading and processing (washing).

From harvest to unloading			From unloading to processing		
Normally (hrs)	Maximum (hrs)	Minimum (hrs)	Normally (hrs)	Maximum (hrs)	Minimum (hrs)
26.4	70.5	13.6	7.4	21.0	2.5

The distribution patterns of the normal time lapse between harvesting and unloading and between unloading and processing among the starch factories investigated are as follows:

Time lapse class (hours)	< 6		6 - < 12		12 - < 24		24 - < 36		36 - < 48		48 - < 72		≥ 72	
Frequency	No	%	No	%	No	%	No	%	No	%	No	%	No	%
Harv. to Unload	3	11.1	5	18.5	1	3.7	11	40.8	1	3.7	4	14.8	2	7.4
Unload to Proc.	18	66.7	2	7.4	2	7.4	4	14.8	1	3.7	0	0	0	0

It can be observed from the above table that two thirds of the factories interviewed or 18 out of 27 encounter a delay in delivery after harvest of 24 hours or more.

Fresh Root Delivery and Pricing

Supply Channels: The bulk of the root supply reaching the starch factories (89.2%) is procured through direct contact with farmers. The remainder is channelled through agents and from own land.

In Perak, however, no agents seem to have played any role in the marketing channel, whereas in P.W. and Kedah 31.7% of the total root supply have been handled by agents. This is understandable on account of the long distance between most of the supplying areas and the factories especially in case of P.W. factories where a substantial quantity of roots comes from Perak.

Examining roots: It is not uncommon for starch factory operators to rely on their a priori knowledge of the quality of roots received from different farmers in determining the price. This is due to their previous knowledge of the types of soil cultivated by tapioca farmers and also of their farming practices and other factors determining the quality of roots. However, most of the factory operators (78%) have reported that they do examine the roots whether at farm or factory. The remainder find no need to examine the roots since they already know their quality.

Visual features of good quality roots are listed in the following order according to reporting frequency:

Features	Frequency	
	No	%
(1) Flesh colour: white	18	86
(2) Size: medium	17	81
(3) Appearance of flesh: dry	16	76
(4) Skin colour: Brownish-yellow	13	62
(5) Shape: compact	11	52
(6) Feel of skin: rough	9	43
(7) Taste, age, variety and soil	6	28

Sorting of roots: Most of the respondents (89%) do some sorting upon receiving their supplies of roots. An average of 5% of their total supply is sorted out as damaged and inferior roots and foreign matters.

Determination of root price: In determining prices paid to farmers 25 operators out of 27 (92.6%) have stated that final product prices and quality of roots are the most important factors. Root supply was considered as a secondary factor (40.7% reporting).

Asked if they would be willing to use an objective simple and practical root quality evaluation method if available, most factory operators (25 out of 27) gave affirmative answers. Moreover, they expressed willingness to pay the price according to this evaluation method.

Root prices: The ex-factory prices of roots in 1968 varied among states, among factories and throughout the year. The following table shows the overall , Perak, P. Wellesley and Kedah average ex-factory root prices and their normal, maximum and minimum levels. The table also shows the price range among factories in each case:

	Normally		Maximum		Minimum	
	Average $/pic	Range $/pic	Average $/pic	Range $/pic	Average $/pic	Range $/pic
Perak	2.48	0.80	2.78	0.80	2.29	0.50
P.W.	2.30	1.00	2.86	1.60	1.93	1.30
Kedah	2.08	0.50	2.35	0.80	1.83	0.40
Total(3 states)	2.37	1.10	2.73	2.20	2.13	0.90

About half of the respondents have reported certain degree of seasonal price fluctuation. According to the resulting answers, root prices tend to be relatively high during the months of

February and March and relatively low during the months of September through December. Fluctuation in prices is judged to be caused by supply and/or quality seasonal variation. It should be noted here that supply and quality levels may be positively correlated if supply shortage is caused by unfavourable weather conditions anticipated by most farmers like heavy rain and floods which affect the quality of the harvested roots.

Root transport charges: The 1966 average lorry transport charges over all the factories interviewed on a per picul and per picul/mile bases for different distances were as follows

	$/picul(average)	average distance travelled (miles)	cents/pic/mile
Normally	0.40	33	1.21
Maximum	0.69	59	1.17
Minimum	0.22	14	1.57

e. Production of Starch and Other Products:

It was evident from the survey that the production pattern of the starch products varies between Perak factories on the one hand and P.W. and Kedah factories on the other. Most of the starch in the form of flour (83%) is produced in Perak while most of the pearls (80%) is produced by P.W. and Kedah factories.

The production of flour, pearls and flakes by the factories interviewed is in the percentages 63.8%, 35.9% and 0.3% respectively. Total quantity of all these products combined produced by these factories was approximately 730,000 piculs (=43,000 tons)

Processing recovery: Processing recovery in the production of flour, pearl and flakes combined has been reported as 17.9% on the average, based on gross weight of shipment before sorting. However, this rate seems to vary among different

factories. No difference was observed between flour, pearl or flakes recovery rates within factories. Based on net weight of shipment after sorting (the actual quantity processed), the overall recovery rate was reported to be 18.9% on the average.

Source of water supply: The degree of cleanliness of the starch produced is determined to a considerable extent by the type of water used in separating the starch from the pulp. The sources of water used for root washing and for starch extraction were reported by the 27 factories interviewed as follows:

Source of water	For root washing		For starch extraction	
	No	%	No	%
Well	11	40.7	13	48.2
Pool	10	37.1	11	40.7
River	6	22.2	2	7.4
Public	0	0	1	3.7

When asked if they had any complaints about water supply 10 factories out of 27 expressed no complaints. Most of the rest reported that water was generally insufficient and only few (5 factories) were of the opinion that it was too dirty for starch extraction.

Chip production: Few starch factories (6 out of 27) process chips for animal feed as a side-line secondary enterprise. This helps them utilize some of the roots which are too inferior for economic starch processing and also stabilize the day to day intake flow for the starch factory. However, as revealed by the survey, the utilization of inferior roots as a reason for establishing the chip plant was more important than supply

stabilization. Chips were sold by these 6 factories at a weighted average of $7.00 per picul in 1968.

Marketing of Products:

Disposal of products: According to survey results, starch products have been channelled through export and local markets in 1968 in the following fashion:

Product	Export	Local
	%	%
Flour	22.8	77.2
Pearl	94.6	5.4
Flakes	100.0	0
Refuse	0	100.0

Most of the pearl exported is produced by P.W. and Kedah factories since, as previously mentioned, about 80% of all pearls are produced by these factories of which almost all is exported. In addition about 50% of the flour produced by these factories contribute to the flour export market.

Packaging materials: Various materials and package sizes are used by the starch factories in preparing their final products for the export and domestic markets.

Jute gunny sacks weighing 40 to 160 katies when packed are mainly used for export of flour, pearl and flakes. Cloth sacks weighing 40 to 50 katies are mainly used for local market in packing flour and pearls. One-kati plastic bags are also used for local market by some factories. Paper containers weighing between 42 and 84 katies are used predominantly for export market in packing flour mainly. Bulk handling applies only to refuse which is sold in local market.

Exports: The bulk of starch products geared to export market is channelled by the factory operaters through export agents. Some of those agents may also be shippers. Direct

contact, made by factory operators, with foreign consumers is not so common especially with regard to export of pearls.

The 1968 f.o.b. export prices for the various starch products were reported by the factory operators as follows:

Product	f.o.b. price $/picul					
	Average		Maximum		Minimum	
	Penang	S'pore	Penang	S'pore	Penang	S'pore
Flour	13.44	13.08	15.52	14.25	11.06	
Pearl	14.06		16.19		12.33	12.42
Flakes	16.50		18.50		14.33	

Local market: Various starch products are sold in the local market through marketing intermediaries or directly to user industries and individual consumers. The distribution of sales among the different outlets follows approximately the following pattern:

	Agents	Wholesalers	Retailers	Industries	Indiv.consumers
	%	%	%	%	%
Starch	16	12	37	25	10
Pearl	0	8	42	8	42
Refuse	23	15	12	0	50

In the case of starch and pearl there may be certain degree of mix up between industries and individual consumers resulting from confusing the two concepts "usage" and "consumption". In the case of refuse, however, the individual consumers are, presumably, livestock farmers. The 1968 average ex-factory prices of starch products sold in the local market have been reported as follows:

Product	Unit of sale	Average price in $		
		Normal	maximum	minimum
Flour	100 katies	13.08	14.79	12.05
	40 katies	5.40	6.17	5.00
	1 kati	0.13	0.18	0.11
Pearl	100 katies	14.11	16.07	12.93
Refuse (Dry)	100 katies	8.22	9.10	7.45
Refuse (wet)	100 katies	1.69	1.90	1.36

Interstate difference in average prices was particularly great in the case of wet refuse where the Perak average normal price was $1.22/picul whereas P.W. and Kedah price was $2.20/picul.

Information on the various industries to whom the starch products were sold was limited as most factory operators were extremely reluctant about disclosing even the nature of their consumers for fear of competition. However, in terms of the reporting frequencies based on 11 factories in Perak and one in Kedah, information on flour industrial usage in the local market is as follows:

Industries	No. of supplying factories
Confectionary	9
Mono Sodium Glutamate	5
Meehoon & others	5
Glucose	3
Chemical	2
Biscuit	1
Cloth	1

Capital Investment and Labour

Capital investment: Three major capital investment items comprise total investment in establishing a starch factory:

land, buildings and machinery. The survey has revealed that machinery constitutes the largest capital cost item in a starch plant followed by buildings then land according to the ratio: 6: 3: 2 respectively. Average dollar investment per factory was reported as approximately ₵64,000 for machinery, ₵32,000 for buildings and ₵21,000 for land.

Additional capital was spent by those factories which reported renovation at different points of time. An average of ₵16,000 per factory were spent on items like adding new machineries, extending kiln areas or building extra sedimentation tanks.

Labour requirements: Information on number of skilled and unskilled labourers actually employed as well as that which would be required at full operation was sought during the survey. Unfortunately, no distinction seemed to have been made by the respondents between skilled and unskilled labourers or between the actual number employed and the potential requirements at full operating capacity. Starch factories interviewed employ an average of about 25 labourers per factory during actual operation. These labourers are distributed along the processing chain between feeding the washing machine and packing the final products.

h. Problems:

Various problems of different nature and relative importance have been expressed by the starch factory operators. Only 3 respondents out of 26 did not seem to have any problem in mind. The rest have expressed the following problems in order of importance based on reporting frequencies:

Nature of Problem	Frequency No. reporting
(1) Shortage of roots	15
(2) Shortage of land and rental problems	10

(3) Low prices of finished products	10
(4) Low recovery	3
(5) Transport difficulty during rainy season	3
(6) Capital shortage	3
(7) Obsolete machinery	2
(8) Low utilization of capacity	1
(9) Lack of cooperation between factories	1
10) Production too high	1
11) Freight more expensive from Malaysia than Thailand	1
12) Competition from imports of Thai refuse in local market	1
13) Difficulty to market product when producing at full capacity	1

Other than the traditional complaint about low prices, it seems apparent that root supply, its shortage and uncertainty, as implied in the present land use problems, constitute major difficulties encountered by starch factory operators at the present time.

(2) Chip Factories

a. General Particulars:

Ownership status: Most of the 27 chip factories interviewed (22 or 81.5%) are owned by private individuals, the rest being owned by partnerships. No cooperatives exist in the chip manufacturing industry.

Age of factories: Chip factories visited, all of which are in Perak are relatively new. Their average age is 6.4 years. The following table shows their age structure:

Age class (yrs)	< 5		5-<10		10-<15		15-<20		20	
	No	%	No	%	No	%	No	%	No	%
Frequency	13	48.1	8	29.7	5	18.5	1	3.7	0	0

Only 6 factories aging 7.5 years on the average have undergone renovation averaging in age 2.7 years.

b. Capacity

Machines: In terms of number of slicing machines installed the average operating capacity for the chip factories interviewed is as small as 1.33 machines per factory distributed as follows:

Factories Installing

	1 Mach		2 Mach		3 Mach		4 Mach		5 Mach	
	No	%	No	%	No	%	No	%	No	%
Frequency	21	77.8	4	14.8	1	3.7	1	3.7	0	0

Total fresh root intake per hour of machine operation for all factories is 2,042 piculs (or 122 tons) averaging 75.6 piculs (or 4.5 tons) per factory/hour. The machine hourly intake of fresh roots is distributed among the 27 factories as follows:

Factories slicing per hour (piculs of roots)

	<20		20-50		50-100		100-200		>200	
	No	%	No	%	No	%	No	%	No	%
Frequency	2	74	9	33.3	9	33.3	3	11.1	4	14.9

Thus two thirds of the chip factories are of a medium to small type slicing between 20 to 100 piculs per hour.

Drying yards: The average drying yard area per factory is 0.728 of an acre distributed as follows:

Factories having drying area(s) of

	¼ acre		¼-½		½-1		1-1½		1½-2		>2	
	No	%	No	%	No	%	No	%	No	%	No	%
Frequency	5	18.5	2	7.4	10	37.1	6	22.2	3	11.1	1	3.7

Total capacity of drying yards for all chip factories interviewed is 3,836 piculs (or 228 tons) of fresh roots, thus averaging 195 piculs (or 1.2 tons) per acre. The time required for this holding capacity naturally varies according to weather

conditions. In a clear sunny day average drying time has been reported as one day or less whereas under overcast weather conditions an average time of almost three days is required for the chips to dry.

During the drying process chips may occasionally get wet due to rain coupled with unavoidable delay in collecting and sheltering them, which would adversely affect the quality of the dry chips and change their colour. This hazardous situation is revealed by the survey to confront 11.1% of the factories interview rather frequently, 51.9% occasionally and 37.0% rarely.

Root intake: Actual root intake for all factories interviewed during 1968 was 753,800 piculs (or 44,869 tons) averaging 27,918 piculs (or 1,662 tons) per factory. The distribution of the total quantity of root intake in 1968 among factories was as follows:

Class (1,000 piculs)	< 5		5-<10		10-<20		20-<50		> 50	
	No	%	No	%	No	%	No	%	No	%
Frequency	0	0	3	11.1	7	25.9	13	48.2	4	14.8

Machine daily operating hours: Because of the production bottleneck caused by sun-drying, slicing machines cannot operate more than a very limited time daily (usually in the morning). Average number of daily operating hours of machines have been reported as 2.3 hours normally with a maximum of 5.0 hours. Other factor limiting any increase in the utilization of the machine daily capacity is root shortage. But of course this factor does not become significant unless the drying yards are under-utilized.

c. Fresh Root Supply

Distance: Average distance between the 27 chip factories interviewed (all in Perak) and farms is normally 9.6 miles ranging

between 1.5 and 25.0 miles. Maximum distance is 25.7 miles on the average ranging between 2.0 and 80.0 miles.

Origin: Land owned by chip factory operators supplies 12.3% of the total root intake. The remainder comes from Kampong farms and jungle cultivation between which the distinction is quantitatively unreliable for reasons previously mentioned.

Flow pattern: About half of the respondents reported an even flow of root supply throughout the year. The other half reported uneven supply throughout the year mainly due to seasonal planting and harvesting necessitated by weather constraints like rainfall and flood. The overall seasonality in supply reported by 6 factories was not, however, sufficiently identified due to considerable variation in individual seasonality patterns. The following table shows the overall monthly supply pattern of roots in percentages:

% of overall monthly supply

Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
8.9	8.9	6.5	5.7	7.7	9.5	9.1	7.8	8.6	10.2	8.4	8.7

Time lapse: The time lapse between harvesting of roots and unloading at the chip factory is normally 19.3 hours on the average while between unloading and processing (slicing) is 27.3 hours on the average. The roots, apparently, have to be stored at the factory due to drying bottleneck and also due to the fact that their flow from the farms cannot be stopped for fear of losing a farmer customer to another chip factory. This delay between harvesting and processing which amounts to almost two full days coupled with the imperfect drying process undoubtedly contribute to lowering the quality of the finished product of dried chips.

d. Fresh Root Delivery and Pricing

Other than the portion of supply originated from own land, chip factory operators contact farmers directly for all their root supplies. Thus, no marketing intermediaries play any role in delivering the roots to the chip factories.

Examining roots: Most chip factory operators (24 out of 27) do examine the roots upon arrival. Visual features of good quality roots are listed in the following order according to reporting frequency:

Features	Frequency	
	No	%
(1) Shape: Compact	12	50
(2) Size: medium to small	11	46
(3) Flesh colour: white to yellowish	9	39
(4) Flesh appearance: dry looking	7	30
(5) Ripeness: fully ripe	4	17
(6) Feel of skin: rough	3	13
(7) Skin colour: brownish	1	4

Many respondents stated that good quality roots come from ploughed soil of good fertility.

Sorting of roots: Roots are normally sorted before putting in the slicing machines to discard bad tubers and foreign matters. Most operators (85%) do this sorting at the factory, the rest, in the field before loading. Approximately 2.4% of the total quantity received is sorted out.

Determination of root price: According to survey results, root prices are mostly determined on the basis of prices of finished product taking the quality of roots into consideration. In addition, the level of root supply determines to a certain extent prices paid to farmers by chip factory operators.

Root prices: ex-factory root prices paid by Perak chip factory operators in 1968 were as follows:

	Normally		Maximum		Minimum	
	Ave	Range pts.	Ave	Range pts.	Ave	Range pts.
$/picul	2.30	1.80-2.60	2.59	1.90-3.07	2.10	1.50-2.50

Root transport charges: The 1968 average lorry transport charges for all the chip factories interviewed on a per picul and per picul/mile bases for different distances were as follows:

	$/picul	ave distance travelled (miles)	cents/pic/mile
Normally	0.325	11.6	2.8
Maximum	0.512	31.7	1.6
Minimum	0.285	6.5	4.4

e. Production of Chips

During 1968, total production of chips reported by the 27 factories in Perak was 302,290 piculs (or 17,993 tons) averaging 11,196 piculs (or 666 tons) per factory and ranging between 3,600 and 28,800 piculs.

Processing recovery: Chip/root recovery rate for all factories was reported to be 40.1% for the total shipments of roots received, i.e., before sorting, while the recovery rate calculated on the basis of only those roots which have been sliced (after sorting) was 41.0%. Percentage recovery range between factories was from 38.0% to 50.0% in the first case and 39.2% and 52.9% in the second.

Packaging material: Chips are always packed in gunny sacks normally weighing (after packing) 110 to 120 katies. Some packs weigh 100 to 109 katies and only few exceed 120 katies.

f. Marketing of Chips

Storage time: Chip factory operators are not normally able to dispose of their product as soon as it is packed. They therefore, store it in gunny sacks in a store room for a period averaging 11 days before disposal and ranging, among factories between one day and three months. The average maximum storage time has been reported to be 42 days ranging, among factories, between 7 days and 6 months.

Disposal of chips: The total quantity of chips sold by the 27 Perak chip factories in 1968 was reported to have been disposed of according to the following outlet pattern:

Outlets	% quantity	No.of factories supplying
Farms	23.2 %	14
Feed mills	33.8 %	10
Dealers & agents	16.3 %	8
Wholesalers	18.0 %	4
Retailers	8.7 %	6

Chip prices: The ex-factory chip prices in 1968 were as follows:

Normal		Maximum		Minimum	
Ave $/pic	Range points $/pic	Ave $/pic	Range points $/pic	Ave $/pic	Range points $/pic
7.47	6.50-8.50	8.06	6.80-10.00	7.00	5.00-7.80

g. Capital Investment and Labour

Capital: The major components of capital invested in a chip factory are: (1) cost of land (2) drying yard construction cost (3) cost of buying and installing the slicing machineries and implements and (4) cost of necessary buildings.

As would be expected, information on cost of land was not easily obtainable because of the different statuses and methods of land acquisition which made it difficult for all except three factories to place a cost figure on land.

Because of the small representation of the land component in the total capital investment, the following table shows a breakdown of capital investment components including and excluding land, based on per factory average:

Investment items	No.Reporting	Average per factory $	% of total invest including land %	% of total invest excluding land %
Land	3	5,667	45.3	-
Drying yard	24	3,779	30.2	55.3
Slicing machine	23	1,320	10.6	19.3
Buildings	19	1,736	13.9	25.4
Average total investment			100.0	100.0
Incl. buildings		12,502		
Excl. buildings		6,835		

Cost of renovation undertaken by four factories (out of six) was reported to be $1,250 per factory on the average. Renovation cost pertinent to the remaining two factories was not available.

Labour: Average hourly labour required by chip factories has been reported to be 8.4 hours per day per factory ranging between 6.0 to 11.0 hours.

Because of the nature of demand for labour in chip factories which, in most cases, necessitates the employment of many labourers during relatively short times, chip factories employ as many as 6.65 workers per factory, though total labour

required average only 6.4 hours per day. This results in the employment of part-time and family labour to tackle the urgent, labour using jobs of short duration like slicing and spreading the sliced roots over the drying yard, collecting, bagging and storing the dried chips and sheltering the semi-dried chips from impending rain.

Chip factories interviewed vary in the number of workers required from 2 to 16 workers. This is naturally due to the large spread in production capacities among factories interviewed which as previously indicated ranged between less than 20 piculs per hour to more than 200 piculs per hour.

h. Problems

Chip factory operators were given a chance to express the problems which they faced. Only three operators out of 24 reporting did not think of any problem. The rest have mentioned the following problems which are hereby listed in order of their importance based on reporting frequencies:

Nature of problem	Frequency No. Reporting
(1) Shortage of roots	10
(2) Shortage of capital	9
(3) Low price of chips	8
(4) Limited market for chips	6
(5) Shortage of land for tapioca cultivation	4
(6) Rain problems	4
(7) Difficulty of root transport	3
(8) Expensive transport	1
(9) Too many factories	1
(10) Labour shortage	1
(11) Temporary occupation license system (T.O.L.) of land use undesirable - prefer rent	1

By examining the difficulties confronting chip and starch factories, it becomes apparent that both, place the highest importance on the root shortage problem. Though the complaint of lack of capital, for expansion purpose, in case of the chip factories, may seem to be contradictory to that of root shortage, it most probably results from the processing bottle-neck (drying) encountered in chip processing under present method of sun-drying. An additional drying space, which, as previously indicated, comprised 75.5% of total capital investment, contributes substantially to the expansion of the factory's scale of operation. Moreover, shortage of capital in the form of liquid money to finance root buying operations and credit extension to farmers has been a major problem confronting chip factory operators.

V. SUMMARY AND CONCLUSIONS

Tapioca has been, for some time, an established export oriented industry in West Malaysia. Nevertheless, it has been, until recently, much neglected by the Federal and the State Governments. As a potentially promising crop for expansion, tapioca was considered, among others, in the First Malaysia Plan in order to diversify agriculture and agricultural industries.

This change in view coupled with the existence of certain fundamental problems facing the tapioca industry at present, have necessitated the conduction of this survey in order to develop more insight into the functioning of the industry, to examine its development potentials and to present to policy makers relevant recommendations.

World Production and Trade

Tapioca is grown in many tropical countries of the world. Since the majority of these countries grow tapioca almost exclusively for home consumption, only few enter into world market, exporting tapioca products in the form of starch for food and nonfood industries and chips, broken roots, meal and pellets for animal feed industry. Brazil is the largest producer of tapioca roots and Thailand is the largest exporter of tapioca products. Though Malaysia's tapioca acreage is relatively very small, its yield per unit of land measure is, according to published world statistics, the highest among exporting countries. Moreover, next to Thailand, though by a very wide margin, Malaysia has the most export oriented production.

The most important markets for tapioca starch are U.S., U.K., Japan and Canada, whereas the most important markets for animal feed tapioca products are the EEC countries, mainly Germany (the largest), the Netherlands and Belgium. Imports into these markets come mainly from Thailand and partly from Brazil, Indonesia, Malaysia, Angola, Togo, Taiwan, Mainland China, Singapore, Tanzania and others.

Tapioca starch is mainly used in textile, paper and adhesive industries and for thickening foodstuffs. Its imports into the various markets have recently followed varying trends. Imports of tapioca starch into the U.S. have increased remarkably between 1962 and 1965 but have been steadily declining since 1966 as tapioca starch seems to have lost ground to other substitute starches. Imports into the U.K. market, mainly supplied from Malaysia, have trended downwardly since 1965 and are unlikely to recover in the near future especially since most of the tapioca starch used in U.K. goes to food industries which have limited opportunity for expansion. Japan has been a rapidly expanding market for tapioca starch. Quantity imported has increased three times between 1965 and 1967. Canada also has expanded its tapioca starch imports considerably between 1965 and 1967.

The EEC countries have more than doubled its imports of animal feed tapioca products in the form of dried roots since 1962. Tapioca meal imports have been declining steadily while tapioca pellets are becoming increasingly popular. The imports of animal feed tapioca products into the EEC countries are largely determined by the following factors: (1) domestic crop of feed grains, (2) prices of tapioca and (3) the Common Agricultural Policy of the EEC. Import levies on dried tapioca roots were reduced to 6% from January 1968. Coupled with higher common grain prices for the crop year 68/69 would favour tapioca products particularly dried roots. This trend should continue in the near future. However, any forcast assumes that supplies of an acceptable quality will continue to be available at prices, including import duties or levies, that can compete with those of feed grains. Main factors contributing to the marketability of tapioca products and to the expansion of producing countries' exports in the foreign markets are, therefore, (1) Price level (2) Quality and (3) Regular supplies.

Animal feed tapioca products, being used as fattening agent in the feed ration, compete with barley and maize in the EEC countries.

At present tapioca competes with barley in Germany and with maize in the Netherlands and Belgium. The extent of use of tapioca in the compound feeding stuff by the feed millers in these countries is thus determined by the feeding value and relative prices.

Among the various forms of animal feed tapioca products, pellets seem to have the brightest future as a feed ingredient, if produced in sufficient quantity. The reasons behind this are: (1) pelletized cargo is more popular as freight charges are lower, (2) handling charges for loading and unloading are also cheaper and easier, particularly if users are equipped with elevators and silos, (3) pellets require less space. Manufacturers can save 20 - 25% storage capacity by using pellets and (4) quality is more uniform. Generally speaking, there is a definite trend towards using pellets in the compound feeding stuff industry. Ever increasing production, modernization of plants and introduction of more silos, will give it added incentive.

The level of demand for animal feed as a whole depends upon livestock number and consumption per head. In the major EEC countries livestock number did not increase significantly between 1962 and 1966, whereas consumption per head in the region as a whole increased to a considerable extent especially in Germany. The resulting overall demand for animal feed as a whole had a definite upward trend.

Among the three major tapioca importing countries of the EEC, the Netherlands and Belgium are more quality minded. Quality standard for dried roots values for (1) minimum starch contents, (2) maximum moisture content, (3) maximum raw fibre content, and (4) maximum ash (or sand) content. Exposing dried roots to water or moisture during and after processing would diminish starch contents and change the colour of finished product.

Present Situation in West Malaysia

Most of the cultivation and processing of tapioca is concentrated in the States of Perak, Province Wellesley and Kedah. Other States have varying acreages of tapioca grown mostly for home food consumption.

The environmental conditions prevailing in West Malaysia seem to be quite favourable for growing tapioca. This should result (as figures have generally indicated) in a relatively high yield per unit of land, labour and capital resources especially when the tapioca industry gets sufficient attention from all concerned.

Until recently, tapioca cultivation has, generally, been discouraged by state governments. However, a switch in attitude is presently taking place in many states. Positive encouragement lead by the Pahang State Government, in connection with the Tapioca Industry Pilot Project, is being observed in some states.

Substantial land areas which are physically suitable for growing tapioca are available in several states. Other than the present expansion in tapioca acreage which is taking place in Pahang (in connection with the Pilot Project), in Johore (6,000 acres alienated in J.B. district), and in Negri Sembilan (10,000 acres approved for alienation), there are approximately 400,000 acres all over the country from which land may be alienated for crop cultivation including tapioca. However, the chances of tapioca cultivation for processing purpose may be slimmed in some states by unsuitable weather and transport conditions as in Trengganu and Kelantan. In other states tapioca expansion may be limited by soil problems, relative profitability of alternative crops and absence of adequate incentives.

Tapioca processing is at present technologically underdeveloped, resulting in a product quality unlikely to meet international standards dictated by competitive markets. In addition, processing methods presently adopted are not conducive to the production of a uniform quality of starch and its derivatives, an essential requirement in export trade.

Exports of tapioca products from West Malaysia amount to about M$5 million annually in the form of pearls (68%), flour (27%) and flakes (4%). In 1968 tapioca pearls were exported to Pakistan,

U.K., Ceylon, Belgium and Luxemburg, Australia and Burma, in this order of export volume. The bulk of tapioca flour went to Singapore and flakes were exported to Singapore, U.K., Italy and Portugal. Exports as a whole trended downwardly especially between 1964 and 1967.

Imports of tapioca products into Malaysia are in the form of refuse which comes from Thailand in increasing quantities annually. These imports seem to be competing favourably with the domestic production on account of better and more uniform quality and lower prices.

The domestic market for tapioca starch is represented mainly by Monosodium glutamate and glucose industries. The former industry uses at present 350 tons of tapioca flour per month (or 4,200 tons per year). However, this quantity is expected to increase in 1972 to 850 tons per month (or 10,200 per year). The latter industry uses at present 270 tons per month (3,240 tons per year) and there is no indication of significant future expansion of this quantity. Glucose is mostly marketed locally to confectionary factories. Small amount is being exported.

Since glucose has been produced locally, imports have dropped from an average of 1,450 tons annually in 64/65 to an average of 33 tons annually in 66/67. On the other hand exports have increased from 3 tons average of 64/66 to 57 tons in 1967. Present domestic market demand is evidently adequately satisfied by local production.

The alcohol industry is expected to use tapioca roots rather than molasse in 1970. Annual intake is expected to approximate 7,000 tons of roots (at present utilization capacity which is 36%). Prices which would make tapioca roots and molasse equally economical for producing alcohol are $2/picul for roots and $85/ton for molasse.

Other domestic outlets for starch products are provision shops selling directly to consumers, small food industries like bee hoon, noodles, ice-cream, biscuits, confectionery, fish and prawn chips etc. Tapioca chips and refuse are at present sold to feed mills and livestock farmers.

The Survey of Factories

Most of the starch and chips factories numbering 54 in the major tapioca States of Perak, Province Wellesley and Kedah were covered by a field survey. Information sought was mainly concerned with: general particulars, capacity, fresh root supply conditions, production and marketing of finished products, capital investments and general problems confronting operators.

Starch factories are in general considerably older than chip factories, the former averaging in age 25 years while the latter only 6 years.

In terms of fresh root intake the average annual capacity of a starch factory is 9,257 tons utilizing only 60% of the maximum attainable capacity. Average annual root intake of a chip factory is 1,662 tons. More than two thirds of the chip factories are of a medium to small size, having only one slicing machine each. Processing bottlenecks of starch and chip factories are represented by those operations that require waiting time like sedimentation (tanks), heat-drying (kiln space) and sun-drying (yard space).

In chip processing, moisture caused by sudden rain occasionally interrupts the sun-drying operation and affects the quality of the dried chips. Sundrying seems to be an impeding factor in the development of the tapioca chip production.

Fresh roots are transported for distances averaging 28 miles and 10 miles to starch and chip factories respectively. Long distance of haul, bad road conditions, and consequent delay in delivery are observed difficulties particularly with regard to supply coming from illegal cultivation which comprises the greater part in the survey region. Time lapse between root harvesting and unloading at the factory is normally 19 hours for chip factories and 26 hours for starch factories. However, delay in processing after delivery is much longer in case of chip factories than in starch factories, the former being 27 hours and the latter 7 hours.

Visual subjective method is used by factory operators to judge the quality of roots for starch and chip processing. Colour and appearance of flesh and size and shape of roots seem to be the most important features considered. For a given quality of roots, prices paid are mostly determined by the prices of finished product. Observed slight seasonal variation in root prices may be due to seasonal variation in supply and quality of roots caused by weather conditions.

All chip factories in the survey region are found in Perak. Starch in the form of flour is mostly produced in Perak whereas most of the pearl is produced by Province Wellesley and Kedah factories. Processing recovery in starch production is 18% in the average and in chip production is 40%. However, these rates which are based on gross weights increase slightly (by 1%) if the portion of roots sorted out before processing is excluded.

Tapioca starch products are channelled through export as well as local markets in varying proportions according to product. The bulk of pearls and flakes is exported whereas the larger proportion of flour is channelled locally. Chips are all sold to farmers and feed mills directly or through marketing intermediaries. Average F.O.B. prices of flour, pearl and flakes exported from Penang in 1968 were $13.44, $14.06 and $16.50 per picul respectively. However, these prices varied throughout the year ranging between $11.06 and $15.52 for flour, between $12.33 and $16.19 for pearl and between $14.33 and $18.50 for flakes. Chip prices averaged $7.47 per picul in 1968 ranging throughout the year between $7.00 and $8.06.

Capital invested in the tapioca starch manufacturing industry is represented by machineries, buildings and land in the proportions 6:3:2 respectively. Average dollar values of these components per factory are $64,000, $32,000 and $21,000 respectively. In chip manufacturing industry, drying yard construction constitutes the largest capital outlay (excluding land for which information is unreliable) followed by buildings then slicing machines in the following approximate proportion 3:1.5:1. The average per factory dollar

value for these three components is $3,800, $1,700 and $1,300 respectively.

Root shortage and uncertainty of supply are considered by both starch and chip factory operators as the most important problems hindering the progress of the industry. Most of the other problems expressed by the operators are generally derived from the basic present setting of tapioca cultivation especially in Perak which generates raw material supply problems.

VI. RECOMMENDATIONS

1. The bulk of the tapioca industry (production and processing sectors) is, at present, located in the State of Perak, where most of the tapioca is illegally cultivated in the jungle. This state of affair results in the following ill effects:-
   a) The persistence of a situation where large number of individuals are motivated to carry out illegal activities leads to highly undesirable social implications.
   b) The loss of fertility of jungle land, being a valuable national resource.
   c) The loss of potential revenue to the State Government in the form of land tax and rent.
   d) The insecurity of tapioca root supply which results in:-
      i) discouraging capital investment in processing modernization necessary for product quality improvement, and
      ii) causing irregularity in exports which repels potential large buyers.

   It is, therefore, recommended that steps should be taken to review the land alienation and utilization regulations with respect to tapioca cultivation in Perak. Tapioca should be treated like any other export orient agriculturally based industry. Sufficient land should be legally made available to guarantee adequate and regular supply of raw material for the existing factories.
2. The expansion of tapioca cultivation in West Malaysia has good physical potentials. There is at present strong trend toward expanding tapioca acreage in various states for processing purpose. With efficient production, processing and marketing and modernization in the technology of processing resulting in improved standardized quality of products, Malaysia can compete favourably in the following markets:-

a) Japan with respect to tapioca flour.
b) EEC countries with respect to tapioca dried roots, especially in the form of pellets.
c) Local market (feed mills) with respect to tapioca dried roots.

In the context of the current and expected expansion of the industry within a frame-work of efficiency (low cost) and improved standardized quality necessary to compete effectively in the world market, it is recommended that the Government should consider the establishment of a "Tapioca Industry Board" with statutory powers. The main functions of this board may be outlined as follows:-

a) Coordinate present production of tapioca and current and future expansion in its cultivation with internal and external demand for the various products.
b) Collect, analyse and disseminate market information regarding type of product, quantity required, time of delivery, prices, freight rates to and import duties and levies at importing countries, quality specifications, etc. Much of this information could be obtained through establishing close ties with reliable traders in the importing countries experienced in tapioca business.
c) Promote sales of tapioca products in present and potential foreign markets.
d) Ensure strict compliance to the stipulations of the contracts in what concern the volume ordered and shipped, the quality of products, the delivery delays, etc.
e) Maintain quality standards for tapioca products especially those channelled through export markets.
f) Establish liaison with the Agriculture Department and experiment stations at Federal and State levels and with the newly established Malaysian Agricultural Research and Development Institute (MARDI) in order to stimulate the development of agronomical research on tapioca

cultivation and to introduce and intensify extension service among tapioca farmers.

g) establish a system of pricing of tapioca roots at the factory door based on recoverable starch content. The general price level should be announced in advance, reviewed periodically and have a definite relation with the general price level in the ultimate users' market.

3. The development of local demand for agriculturally based industrial products as import substitutes is a highly desirable goal especially at the present stage of this country's economic development. It is, therefore, recommended that steps should be taken to initiate research programmes to investigate the technological and economic aspects of the utilization of tapioca products in the local food and non-food industries.

4. Since the production of tapioca pellets, which seems to have a bright future in the world market (especially the EEC countries), uses of tapioca chips for raw material, it is recommended to encourage the establishment of pelletizing plants where sufficient supplies of standardized tapioca chips are available. These supplies may be obtained on a contract basis from larger chip factories operating at present which would likely fulfil quantity and quality requirements and from new chip factories to be established in tapioca expanding areas and to be integrated with the pelletizing plants. Businessmen from importing countries (preferably Germany) may be attracted to invest, jointly with the Malaysian Government or private local investors, in these pelletizing plants and to operate them.

5. In view of the present state of starch processing methods and equipment prevailing in the country, it is recommended that starch factories should be assessed in the light of processing efficiency, quality of products and expected life of operation. A long-term plan should, subsequently, be drawn in order to decide on dates when certain factories should be renovated,

expanded, replaced by more modern ones or eliminated, and on extending credits and facilities for processing development in general. The decisions would have to be consistent with cultivation pattern and market demands.

6. Since chip sundrying comprises a major obstacle toward the achievement of efficiency and quality objectives, it is recommended that steps should be taken to develop a practical, cheap and efficient method for drying the tapioca sliced roots artificially.
7. Port shipping facilities are important in influencing the cost and quality of exported tapioca products. It is, therefore, recommended that facilities should be available at Penang for bulk loading tapioca products on ships and that custom procedures be streamlined and simplified.
8. The information resulting from the initiation, progress and problems of the Pahang Pilot Project is extremely valuable. It is, therefore, recommended that the details of this information should be carefully recorded, classified and analysed for later use with necessary adaptation to conditions prevailing in other areas in the country where tapioca industry development proves desirable.
9. The East Coast offers a good possibility for establishing a livestock/feed industry with all essential feed ingredients available. It is, therefore, recommended that serious attention should be directed to the establishment of animal feed mills utilizing:-
   a) tapioca chips produced by, and in excess of the needs of, the Pahang Pilot Project.
   b) Maize produced in Trengganu.
   c) Defatted rice bran from Kelantan, North Trengganu and Pahang. In this connection, a rice-bran oil extraction plant would be desirable once the local demand for bran oil is created.
   d) Copra cake from the East Coast states.
   e) Fish meal from Trengganu and the East Coast in general.

A livestock industry could be developed in the East Coast based on dry-lot cattle feeding once grazing areas are made available

to supply the dry-lots with feeder calves. This type of livestock production would, of course, be in addition to pig and poultry production as users of the locally produced animal feed compound.

10. Since present glucose production adequately satisfies the domestic market demand, and since foreign market for glucose is highly competitive, it is recommended that manufacturing glucose should not be considered at present unless there is a definite assurance from potential users to substitute glucose for sucrose in the relevant food industries. Factors to be taken into considerations are: relative prices, processing suitability and consumers' taste.

VII APPENDIX

TABLES

TAPIOCA PRODUCTION AND ACREAGE OF BRAZIL.

	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Acreage	1,255,818	1,239,366	1,342,403	1,381,331	1,476,206	1,617,810	1,715,857	1,749,660	1,779,806	1,914,439	1,900,000
Production	-	-	-	-	19,843	22,249	24,356	24,993	24,710	27,268	26,80

Source: Brazilian Embassy, Bangkok and F.A.O.Production Yearbook 1966-68

Acreage in **hectare**.

Production in '000 tons.

TAPIOCA PRODUCTION AND ACREAGE IN THAILAND.

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Acreage	96,775	94,800	109,020	154,445	176,565	245,295	302,965	345,625	259,120	249,580	387,961	321,242	370,664
Production	396	418	487	1,083	1,222	1,726	2,077	2,111	1,557	1,475	2,323	1,800	2,200

Fact and Figures: An Investors Guide to Thailand, Bangkok Building, Bangkok.

F.A.O. Production Yearbooks 1966-68

Acreage in acres

Production in '000 metric tons.

TOTAL EXPORT OF TAPIOCA PRODUCTS FROM THAILAND, BREAKDOWN BY PRODUCT.

	1963		1964		1965		1966		1967	
	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht
Cassava Meal	189,780	143,061	216,615	142,931	80,026	60,900	67,957	54,253	181,430	147,020
Refuse (Waste)	22,363	15,135	46,794	30,275	99,938	78,774	111,544	86,021	72,791	45,040
Cassava Chips	93,525	76,411	348,384	257,295	408,455	320,975	369,205	284,445	342,629	240,334
Cassava Flour	121,520	203,650	152,432	229,157	141,918	222,569	170,758	257,567	209,336	321,408

Source: Statistical Yearbooks, Thailand 1963-67

Quantity in metric tons

1 US $ = 20.60 Baht

1 M $ = 6.85 Baht.

EXPORT OF CASSAVA FLOUR FROM THAILAND, BREAKDOWN BY COUNTRY

Country	1963		1964		1965		1966		1967	
	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht
U.S.A.	95,816	160,874	116,642	177,616	121,078	190,888	141,957	214,733	120,026	185,813
JAPAN	14,532	23,660	15,488	22,244	16,236	24,157	23,114	33,258	72,352	109,502
OTHERS	11,172	19,116	20,302	29,297	4,604	7,524	5,687	9,576	16,958	26,093
TOTAL	121,520	203,650	152,432	229,157	141,918	222,569	170,758	257,567	209,336	321,408

EXPORT OF CASSAVA CHIPS FROM THAILAND, BREAKDOWN BY COUNTRY

	1963		1964		1965		1966		1967	
	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht
BELGIUM	14,252	11,400	46,801	33,199	14,423	11,041	14,898	11,242	5,478	3,724
JAPAN	47	40	49,844	42,487	2,342	2,095	2,991	2,641	10,268	9,259
W. GERMANY	47,871	39,048	143,917	104,259	182,518	146,412	189,968	147,862	153,310	106,248
NETHERLANDS	31,128	25,766	106,029	75,679	207,091	159,342	160,913	122,377	173,230	120,839
OTHERS	227	157	1,793	1,671	2,081	2,085	435	323	343	264
TOTAL	93,525	76,411	348,384	257,295	408,455	320,975	369,205	284,445	342,629	240,334

Source. Statistical Yearbooks, Thailand 1963-67

Quantity in metric tons

1 US $ = 20.60 Baht

1 M $ = 6.85 Baht.

EXPORT OF CASSAVA MEAL FROM THAILAND, BREAKDOWN BY COUNTRY

	1963		1964		1965		1966		1967	
	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht
W. GERMANY	122,662	91,477	153,152	101,596	60,225	45,936	50,408	39,190	95,069	75,145
NETHERLANDS	49,277	36,386	40,606	26,941	16,078	11,720	15,803	13,456	82,286	68,269
OTHERS	17,841	15,198	22,857	14,394	2,723	3,244	1,746	1,607	4,075	3,606
TOTAL	189,780	143,061	216,615	142,931	80,026	60,900	67,957	54,253	181,430	147,020

Source: Statistical Yearbooks, Thailand 1963-67

Quantity in metric tons

1 US $ = 20.60 Baht.

1 M $ = 6.85 Baht.

EXPORT OF REFUSE (WASTE) FROM THAILAND BREAKDOWN BY COUNTRY

	1963		1964		1965		1966		1967	
	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht	Tons	000 Baht
Malaya	1597	1043	1462	915	8501	6634	13984	9863	18302	9616
W.Germany	7269	5191	31481	20846	74027	58874	83751	65415	44780	29460
Netherlands	-	-	1694	1179	10188	7976	10021	8204	3155	2311
Others	13497	8901	12157	7335	7222	5290	3788	2539	6554	3653
Total	22363	15135	46794	30275	99938	78774	111544	86021	72791	45040

Source:- Statistical Yearbooks, Thailand 1963-67

Quantity in metric tons

Value in 000 Baht

1 US$ = 20.60 Baht

1 M$ = 6.85 Baht

EXPORT OF TAPIOCA PRODUCTS FROM BRAZIL

	1963		1964		1965		1966		1967	
	Q	V	Q	V	Q	V	Q	V	Q	V
Roots	913	171000	1200	204000	41801	1877000	27052	1318000	711	41000
Flour Starch and Flake	10162	609000	63039	2916000	76986	4078000	59941	3581000	19571	1406000
Total	11075	780000	64239	3120000	118787	5955000	86993	4899000	20282	1447000

Source:- Brazilian Embassy, Bangkok

US IMPORT OF CASSAVA FLOUR AND STARCH

	1961	1962	1963	1964	1965	1966	1967	1968
Quantity in 000 Long Tons	139090	74048	110875	133546	162397	154536	137927	87913
Value in 000 US $	-	6040	5998	9566	12195	11461	10686	7059

Source: Bureau of the Census Report FT 110; FT 125; FT 135

U.S.A. Import Of Cassava Flour And Starch. Breakdown by Country

	1966		1967		1968		1969 (First 6 months)	
	lbs	value	lbs	value	lbs	value	lbs	value
Brazil	71785000	2369936	40611236	1462256	26605213	1037899	13530845	518976
Canada	-	-	-	-	-	-	1759200	69758
Argentina	441000	17640	66200	1588	-	-	-	-
Thailand	262431274	8832212	257501516	8991135	164528088	5893759	83258712	2027254
Malaysia	4171770	158414	378490	19897	134350	7801	-	-
Taiwan	425775	14430	3757158	133392	2016732	70416	1327813	41077
Ghana	-	-	-	-	-	-	1116911	34066
Singapore	336000	12264	-	-	78573	2837	-	-
Malaga	225000	20250	80000	7280	80000	7197	-	-
sub-total	339815819	11425146	302394600	10615548	193442956	7019909	100993488	3451941
Others	878542	36175	1683807	70821	372690	39515	195404	14153
Total	340694361	11461321	304078407	10686369	193815646	7059424	101188892	3506094

Quantity in lbs

Value in US$

Source: U.S.A. Embassy, Kuala Lumpur.

IMPORTS OF MANIOC PRODUCTS INTO THE EEC - TOTAL (W. GERMANY, BELGIUM AND NETHERLANDS)

	1962		1963		1964		1965		1966		1967	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dried Roots	71,609.7	5,266.5	195,599.8	12,809.3	363,155.5	22,519.9	555,980.6	36,762.2	607,470.1	40,692.4	656,919.9	-
Meal	318,465.9	20,468.4	268,472.3	15,090.7	220,803.8	11,586.8	140,343.7	8,237.9	260,393.8	15,599.6	147,942.0	6,363
Total	390,275.6	25,734.9	464,072.1	27,900.0	583,959.3	34,106.7	696,324.3	45,000.1	867,863.9	56,292.0	804,861.9	-

Source: National Trade Statistics

EEC Commerce Exterieur 1967

Quantity in metric tons

Value in US$

IMPORTS OF MANIOC PRODUCTS INTO THE EEC - W. GERMANY

	1962		1963		1964		1965		1966		1967	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Dried Roots	66,043.5	4,854.2	147,690.5	9,786.5	272,585.5	16,977.0	387,962.3	25,921.7	453,320.0	30,891.2	395,940.0	-
Meal	300,063.1	19,297.2	239,576.4	13,443.2	188,947.8	9,879.7	131,671.3	7,748.0	248,389.3	14,947.0	136,803.0	7,66
Total	366,106.6	24,151.4	387,266.9	23,229.7	461,533.3	26,856.7	519,633.6	33,669.7	701,709.3	45,838.2	532,743.0	-

Sources: National Trade Statistics

EEC Commerce Exterieur 1967

Quantity in metric tons

Value in '000 US$

IMPORTS OF MANIOC PRODUCTS INTO THE EEC - NETHERLANDS

	1962		1963		1964		1965		1966		1967	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Valu
Dried Roots	25.0	6.1	567.0	32.0	9,788.0	593.6	72,093.0	4,566.5	90,626.0	5,590.0	157,933.0	-
Meal	1,186.0	60.8	4,171.0	219.9	7,247.0	361.3	4,395.0	250.0	4,904.0	217.7	880.0	42.0
Total	1,211.0	66.9	4,738.0	251.9	17,035.0	954.9	76,488.0	4,816.5	95,530.0	5,807.7	158,813.0	-

Source: National Trade Statistics

EEC Commerce Exterieur 1967

Quantity in metric tons

Value in US$

IMPORTS OF MANIOC PRODUCTS INTO THE EEC - BELGIUM

	1962		1963		1964		1965		1966		1967	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Val
Dried Roots	5,741.2	406.2	47,342.3	2,990.8	80,782.0	4,949.3	95,925.3	6,274.0	63,524.1	4,211.2	103,046.1	-
Meal	17,216.8	1,110.4	24,724.9	1,427.6	24,609.0	1,345.8	4,277.4	239.9	7,100.5	434.9	10,259.0	637
Total	22,958.0	1,516.6	72,067.2	4,417.4	105,391.0	6,294.1	100,202.7	6,513.9	70,624.6	4,645.1	113,305.1	-

Source: National Trade Statistics

EEC Commerce Exterieur 1967

Quantity in metric tons

Value in US$

F.O.B. PRICES OF EXPORTED TAPIOCA PRODUCTS FROM THAILAND M$/LONGTON

	1963	1964	1965	1966	1967
Cassava Meal	112	98	113	118	120
Refuse (Waste)	100	96	117	114	92
Cassava Chips	121	110	117	114	104
Cassava Flour	249	223	233	224	228

Computed from: Statistical Yearbooks, Thailand 1963-67.

1 M$ = 6.85 Baht

TAPIOCA ACREAGE IN PERAK AND W. MALAYSIA TOTAL 1961-68

	1961		1962		1963		1964		1965		1966		1967		1968	
	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop	Sole Crop	Mixed Crop
Perak	10130	1790	24718	1740	32845	4580	25740	4070	20880	5850	18770	6335	22665	6123	19352	10860
Total W.Malaysia	22570	17714	37563	18072	46078	17625	35245	20563	30592	19528	26432	19576	34567	20435	26502	31124

Source: Acreages of Miscellaneous crops, Ministry of Agriculture and Cooperatives, 1967 and 1969

Acreage in acres.

TOTAL EXPORTS OF TAPIOCA PRODUCTS FROM W.MALAYSIA. 1963-68

1963		1964		1965		1966		1967		1968	
Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $
21999	5786	24849	4860	23834	5285	18232	4545	16239	4579	18234	4542

Source: External Trade Statistics, Department of Statistics, Malaysia.

EXPORT OF TAPIOCA FROM W. MALAYSIA 1963-68 (BREAKDOWN BY PRODUCT)

	1963		1964		1965		1966		1967		1968	
	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $	Quantity Ton	Value 000 $
Tapioca Pearl	14719	4122	14462	2958	12506	3107	9776	2589	11850	3414	13082	3313
Tapioca Flour	6031	1439	8756	1656	8254	1688	7516	1761	3726	964	4355	1020
Tapioca Flakes	1040	203	1354	216	2162	348	860	182	647	199	797	209
Roots + Refuse	209	22	277	30	912	142	80	13	16	2	-	-

Source: External Trade Statistics, Department of Statistics, Malaysia.

EXPORT OF TAPIOCA PEARL FROM W. MALAYSIA 1963-68 (BREAKDOWN BY IMPORTING COUNTRY)

-	1963	1964	1965	1966	1967	1968
	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons
Australia	564	703	762	757	711	777
Belgium/ Luxemburg	708	588	549	723	873	870
Burma	1548	860	1000	-	1000	100
Ceylon	1595	2297	2200	1464	1634	2340
Pakistan	4441	4518	2385	1917	2362	3881
U.K.	3364	3111	3246	2871	3148	2885
OTHERS	2499	2385	2364	2044	2122	2229
Total	14719	14462	12506	9776	11850	13082

Source: External Trade Statistics, Department of Statistics, Malaysia.

EXPORT OF TAPIOCA FLOUR FROM W. MALAYSIA 1963-68 (BREAKDOWN BY IMPORTING COUNTRY)

	1963	1964	1965	1966	1967	1968
	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons
Burma	666	116	72	40	47	-
Singapore	2480	5813	4746	4577	3159	4090
U.S.A.	2072	1085	2121	1700	-	-
OTHERS	813	1742	1315	1199	520	265
Total	6031	8756	8254	7516	3726	4355

EXPORT OF TAPIOCA FLAKE FROM W. MALAYSIA 1963-68 (BREAKDOWN BY IMPORTING COUNTRY)

	1963	1964	1965	1966	1967	1968
	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons	Quantity in Tons
Italy	52	44	69	62	82	100
Portugal	7	10	46	70	57	94
Singapore	587	892	1352	493	193	331
United Kingdom	335	290	223	176	219	196
OTHERS	59	118	472	59	96	76
Total	1040	1354	2162	860	647	797

Source: External Trade Statistics, Department of Statistics, Malaysia.

W. MALAYSIA F.O.B. PRICES 1962-68

	1963	1964	1965	1966	1967	1968
	Price Ton $	Price Ton $	Price Ton $	Price Ton $	Price Ton $	Price Ton $
Tapioca Pearl	280	205	248	265	288	253
Tapioca Flour	239	189	204	234	259	234
Tapioca Flakes	195	159	161	211	307	262
Weighted Average of Pearl, Flour & Flake	265	197	224	250	282	249

F.O.B. PRICES OF EXPORTED FLOUR FROM MALAYSIA AND THAILAND

Malaysian $/Long Ton

	1963	1964	1965	1966	1967	1968
Malaysia	239	189	204	234	259	234
Thailand	249	223	233	224	228	

Computed from: Malaysia's External Trade Statistics. Statistical Yearbooks, Thailand

F.O.B. PRICES OF EXPORTED REFUSE FROM MALAYSIA AND THAILAND

Malaysian $/Long Ton

	1963	1964	1965	1966	1967
Malaysia	107	123	155	164	107
Thailand	100	96	117	114	92

Source: Malaysia's External Trade Statistics. Statistical Yearbooks, Thailand

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